PCI-8136M

6-Axis Motion Controller Card

User's Guide

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Manual Rev. 1.00: Oct 20, 2000

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Questions	
Product Model	
Environment to Use	OS _____ Computer Brand M/B: CPU: Chipset: BIOS:: Video Card : Network Interface Card: Other:
Challenge Description	
Suggestions to ADLINK	

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How to Use This Guide

This manual is designed to help you use the PCI-8136M. The manual describes how to modify various settings on the PCI-8136M card to meet your requirements. It is divided into five chapters:

- **Chapter 1**, "Introduction", gives an overview of the product features, applications, and specifications.
- **Chapter 2**, "Installation", describes how to install the PCI-8136M.
- **Chapter 3**, "Signal Connection", describes the connectors' pin assignment and how to connect the outside signal and devices with the PCI-8136M.
- **Chapter 4**, "Operation Theorem", describes detail operations of the PCI-8136M.
- **Chapter 5**,"Motion Library", describes high-level programming interface in C/C++ language. It helps programmer to control PCI-8136M in high-level language style

1

Introduction

The PCI-8136M is a 6 axes motion control card with PCI interface. It supports two kinds of motor driver, Pulse type and voltage type. It can generate pulse trains or voltage commands for servo motors or stepping motors. The PCI-8136M is composed of 6 sets of motion control module. Each control set has its own pulse generator, encoder counter, analog output, dedicated I/O and analog input. When one axis is not for motion control, all of the components in the motion set can be used individually. Therefore, the PCI-8136M has maximum flexibility on industrial applications.

Figure 1.1 shows the function block diagram of PCI-8136M card. PCI-8136M uses one motion control ASIC to perform 6 axes motion control. This ASIC outputs the velocity profile through DDA module from the motion library. It supports one axis PTP, two axes linear interpolation, two axes circular interpolation, three axis linear interpolation with linear and S-curve acceleration/deceleration velocity profiles.

The PCI-8136M can work with Microsoft Windows series without any real-time OS. The PCI-8136M supports Windows DLL and drivers. Users can develop their own applications by Visual C++, Visual Basic, C++ Builder or Delphi. It is very easy to use PCI-8136M's function library because all functions are not register based. They are very easy for use and friendly to every modern PC users. It also can work with MS-DOS with Borland C++ 3.1.

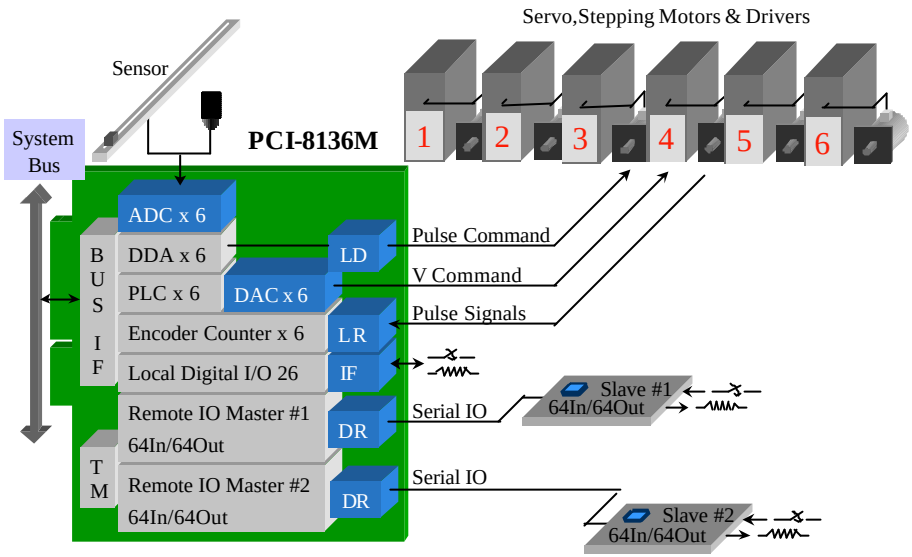


Figure 1.1 Block Diagram of PCI-8136M

1.1 Functionality of PCI-8136M

The PCI-8136M is composed of 6 sets of motion control module. Each control set has its own pulse generator, encoder counter, analog output, dedicated I/O and analog input. When one axis is not for motion control, all of the components in the motion set can be used individually.

The following table regards the number of motion axes and remaining available functions.

No. of Motion Axes / Remain Functions	0	1	2	3	4	5	6
Analog Input	6	6	6	6	6	6	6
Analog Output	6	(5) 6	(4) 6	(3) 6	(2) 6	(1) 6	(0) 6
Digital Input	19	15/19	12/19	9/19	6/19	3/19	0/19
Digital Output	7	6/7	5/7	4/7	3/7	2/7	1/7
Pulse Input (Encode Counter)	6	5/6	4/6	3/6	2	1	0
Pulse Output (Pulse Generator)	6	6	5	4	3	2	1

Note: () means close loop control mode with v command output is set.

For example: If 2 motion axes are used, it remains

① 6 AI

② 4 or 6 AO(depends on command type)

③ 12 or 19 DI (depends on if motion I/O is active or not)

④ 4 or 7 DO (depends on if servo-on is used nor not)

⑤ 4 or 6 encoder counters(depends on if motion feedback is connected nor not)

⑥ 4 pulse generators for general use

1.2 Features

The PCI-8136M gets the following features:

- Compact, half size PCB
- 32-bit PCI-bus, plug and play
- 6 channels 16-bit analog output
- 6 channels 12-bit analog input
- 19 channels isolated digital input
- 7 channels open collector digital output
- Programmable interrupt sources
- 6 differential types 32-bit encoder counters
- 6 differential type pulse generators
- 2 optional remote I/O modules with 128 I/Os
- One 24-bit programmable timer
- Software supports maximum up to 4 cards
- 6-axis motion control ability with voltage(closed-loop) & pulse(open loop) type command output
- Applicable motor type: Analog & digital servo, stepping & micro stepping
- Support Trapezoidal and S-curve velocity profile for every motion functions
- One axes PTP control
- Any 2 axes linear interpolation
- Any 2 axes circular interpolation
- Any 3 axes linear interpolation
- Function library for DOS and Windows 95/98/NT/2000
- Real Time OS needless

1.3 Specifications

1.3.1 Applicable Motors:

- Stepping motors
- AC or DC servomotors with pulse train input servo drivers
- AC or DC servomotors with velocity command (analog) input servo drivers

1.3.2 Motion

- Number of controllable axes: selectable **1~6** Axes
- Motion command output type: selectable **Voltage** or **Pulse** command
- Max NO. of cards in one system: 4
- Pulse command output up to 1024KHz
- Control loop cycle time up to 1.024 ms
- Analog command output range: ±10V
- 32-bit 2 MHz Up/Down counter for encoder feed back signals (each axis)
- 32-bit position comparator with interrupt (each axis)

1.3.3 Motion Interface I/O Signals

- 2500 Vrms optically isolated for all Motion Interface IO
- Incremental encoder signals input pins: EA and EB (each axis)
- Encoder index signal input: EZ (each axis)
- Mechanical limit switch signal input pins: ±EL, and ORG (each axis)
- Servomotor interface I/O pins: SVON (each axis)
- Emergency stop signal input: ESTOP

1.3.4 General I/Os

♦ **Analog Input**

- 6 differential input channels
- Input range: Voltage: ±10V
  Current: ±20 mA (manually soldering 124ohms resistor)
- 12-bit ADC with 1-bit non-linearity
- Input impedance : 10^{12} Ohms || 100pF (voltage mode)
  124Ohms (current mode)
- Sampling rate: 133 KHz multiplexing

♦ **Analog Output**

- 6 output channels
- Output range: bipolar, ±10V
- 16-bit DAC resolution, 14-bit accuracy guaranteed
- Settling time: 2 µ second
- Voltage output drive: 5mA max.

♦ **Digital Input**

- 19 input channels for NPN type sensor
- Input impedance: 4.7K Ohms
- Max. Current: 20mA
- Isolated voltage: 2500V RMS
- Throughput: 10KHz (0.1ms)

♦ **Digital Output**

- 7 Output channels
- Output type : Darlington transistor with open collector type (ULN2003A)
- Sink current : 90mA/Ch (typical)

150mA/Ch (max.)

500mA/total

- Isolated voltage 2500V RMS
- Throughput 10KHz(0.1ms)

♦ **Pulse Input (Encoder Counter)**

- 6 differential input channels
- 32-bit counter for AB-phase, CW/CCW, Pulse/Direction modes
- 2500V RMS optical isolation
- Maximum pulse input frequency: 2MHz
- 32-bit encoder counter comparison

♦ **Pulse Output (Pulse Generator):**

- 6 output channels with differential line drivers
- Pulse command type: CW/CCW, Pulse/Direction, A/B Phase
- Maximum pulse rate: 500KHz with 1 μ second pulse width

♦ **Timer:**

- One 24-bit programmable timer
- Base clock: 33MHz from PCI bus

1.3.5 General Specifications

♦ **Connectors:**

♦ **100-pin SCSI-type connector**

- DB25 female connector
- DB9 male connector

♦ **Operating Temperature: 0° C ~ 50° C**

♦ **Storage Temperature: -20° C ~ 80° C**

♦ **Humidity: 5 ~ 85%, non-condensing**

- **Power Consumption:**
  - Slot power supply(input): +5V DC ±5%, 900mA max
  - External power supply(input): +24V DC ±5%, 500mA max
  - External power supply(output): +5V DC ±5%, 500mA, max
- **Dimension: 164mm(L) X 98.4mm(H)**

1.4 Software Supporting

1.4.1 Programming Library

The Programming Library enables motion control functionality of PCI-8136M. It provides versatile function calls for customers who are writing their own motion control programs. The Motion Library supports MS-DOS Borland C/C++ with programming library and Windows 95/98/NT/2000 with DLL.

2

Installation

This chapter describes how to install the PCI-8136M hardware and software correctly. Please follow the follow steps.

Section 2.1 Check what you have

Section 2.2 PCB Outline Drawing

Section 2.3 Install the hardware

Section 2.4 Install the software driver

Section 2.5 CN1 Pin Assignments

Section 2.6 CN2 Pin Assignments

Section 2.7 DB25 Connector

Section 2.8 DB9 Connetctor

2.1 What You Have

In addition to this *User's Guide*, the package includes the following items:

- PCI-8136M 6-axis Motion Controller Card
- DB9 and DB25 Bracket
- External Power cable for CN2
- 124O, DIP type resistance * 6
- ADLINK All-in-one Compact Disc
- PCI-8136M User's Manual

If any of these items are missing or damaged, contact the dealer from whom you purchased the product. Save the shipping materials and carton in case you want to ship or store the product in the future.

2.2 Outline Drawing

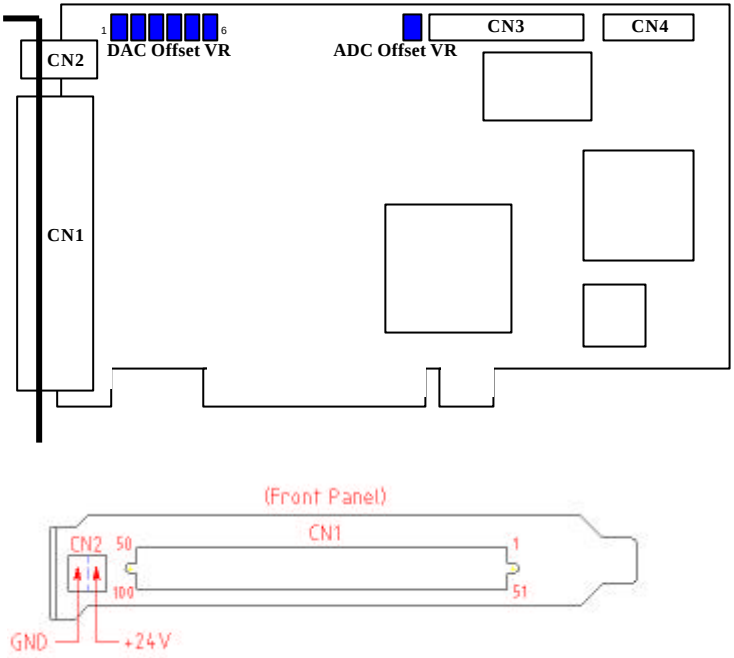


Figure 2.2.1 PCB Layout of the PCI-8136M

CN1 Pin Assignments: Main Connector

CN2 Pin Assignments: External Power Input

CN3 Pin Assignments: DB25 Connector

CN4 Pin Assignments: DB9 Connector

DAC offset VR1~6

ADC offset VR

2.3 Hardware Installation

2.3.1 Hardware configuration

PCI-8136M has plug and play PCI controller on board. The memory usage (I/O port locations) of the PCI card is assigned by system BIOS. The address assignment is done on a board-by-board basis for all PCI cards in the system.

2.3.2 PCI slot selection

Your computer will probably have both PCI and ISA slots. Do not force the PCI card into a PC/AT slot. The PCI-8136M can be used in any PCI slot.

2.3.3 Installation Procedures

1. Read through this manual, and setup the jumper according to your application.

2. Turn off your computer, Turn off all accessories (printer, modem, monitor, etc.) connected to computer.

3. Remove the cover from your computer.

4. Select a 32-bit PCI expansion slot. PCI slots are short than ISA or EISA slots and are usually white or ivory.

5. Before handling the PCI-8136M, discharge any static buildup on your body by touching the metal case of the computer. Hold the edge and do not touch the components.

6. Position the board into the PCI slot you selected.

7. Secure the card in place at the rear panel of the system unit using screw removed from the slot.

2.3.4 Trouble shooting:

If your system won't boot or if you experience erratic operation with your PCI board in place, it's likely caused by an interrupt conflict (perhaps because you incorrectly described the ISA setup). In general, the solution, once you determine it is not a simple oversight, is to consult the BIOS documentation that come with your system.

2.4 Software Installation

Please refer to the ADLINK All-in-one Compact Disc Manual to install it.

2.5 CN1 PIN ASSIGNMENTS: MAIN CONNECTOR

The CN1 is the major connector for the Motion related I/O, including pulse output, encoder feedback input, Analog output and interface IO signals.

No.	Name	I/O	Function	No.	Name	I/O	Function
1	AGND	SG	Analog ground	51	AGND	SG	Analog ground
2	DAC1	O	Analog output, ①	52	DAC4	O	Analog output, ④
3	DAC2	O	Analog output, ②	53	DAC5	O	Analog output, ⑤
4	DAC3	O	Analog output, ③	54	DAC6	O	Analog output, ⑥
5	ACC+5V	O	+5V from PC	55	COM-	PG	+24V Ground
6	COM+	P	+24V Input for Digital I/O	56	COM-	PG	+24V Ground
7	COM+	P	+24V Input for Digital I/O	57	ESTOP	I	Emergency stop signal
8	COM+	P	+24V Input for Digital I/O	58	PRDY	O	General-purposed output
9	ORG1	I	Origin signal, ①	59	ORG2	I	Origin signal, ②
10	PEL1	I	End limit signal (+), ①	60	PEL2	I	End limit signal (+), ②
11	MEL1	I	End limit signal (-), ①	61	MEL2	I	End limit signal (-), ②
12	SVON1	O	Servo on signal, ①	62	SVON2	O	Servo on signal, ②
13	ORG3	I	Origin signal, ③	63	ORG4	I	Origin signal, ④
14	PEL3	I	End limit signal (+), ③	64	PEL4	I	End limit signal (+), ④
15	MEL3	I	End limit signal (-), ③	65	MEL4	I	End limit signal (-), ④
16	SVON3	O	Servo on signal, ③	66	SVON4	O	Servo on signal, ④
17	ORG5	I	Origin signal, ⑤	67	ORG6	I	Origin signal, ⑥
18	PEL5	I	End limit signal (+),⑤	68	PEL6	I	End limit signal (+),⑥
19	MEL5	I	End limit signal (-),⑤	69	MEL6	I	End limit signal (-),⑥
20	SVON5	O	Servo on signal, ⑤	70	SVON6	O	Servo on signal, ⑥
21	EA1+	I	Encoder A-phase (+), ①	71	EA2+	I	Encoder A-phase (+), ②
22	EA1-	I	Encoder A-phase (-), ①	72	EA2-	I	Encoder A-phase (-), ②
23	EB1+	I	Encoder B-phase (+), ①	73	EB2+	I	Encoder B-phase (+), ②
24	EB1-	I	Encoder B-phase (-), ①	74	EB2-	I	Encoder B-phase (-), ②
25	EZ1+	I	Encoder Z-phase (+), ①	75	EZ2+	I	Encoder Z-phase (+), ②
26	EZ1-	I	Encoder Z-phase (-), ①	76	EZ2-	I	Encoder Z-phase (-), ②
27	EA3+	I	Encoder A-phase (+), ③	77	EA4+	I	Encoder A-phase (+), ④
28	EA3-	I	Encoder A-phase (-),③	78	EA4-	I	Encoder A-phase (-), ④
29	EB3+	I	Encoder B-phase (+),③	79	EB4+	I	Encoder B-phase (+), ④
30	EB3-	I	Encoder B-phase (-),③	80	EB4-	I	Encoder B-phase (-), ④
31	EZ3+	I	Encoder Z-phase (+),③	81	EZ4+	I	Encoder Z-phase (+), ④
32	EZ3-	I	Encoder Z-phase (-),③	82	EZ4-	I	Encoder Z-phase (-), ④
33	EA5+	I	Encoder A-phase (+),⑤	83	EA6+	I	Encoder A-phase (+),⑥
34	EA5-	I	Encoder A-phase (-),⑤	84	EA6-	I	Encoder A-phase (-),⑥
35	EB5+	I	Encoder B-phase (+),⑤	85	EB6+	I	Encoder B-phase (+),⑥
36	EB5-	I	Encoder B-phase (-),⑤	86	EB6-	I	Encoder B-phase (-),⑥
37	EZ5+	I	Encoder Z-phase (+),⑤	87	EZ6+	I	Encoder Z-phase (+),⑥
38	EZ5-	I	Encoder Z-phase (-),⑤	88	EZ6-	I	Encoder Z-phase (-),⑥
39	OUT1+	O	Pulse signal (+),①	89	OUT2+	O	Pulse signal (+), ②
40	OUT1-	O	Pulse signal (-),①	90	OUT2-	O	Pulse signal (-), ②
41	DIR1+	O	Dir. signal (+),①	91	DIR2+	O	Dir. Signal (+), ②
42	DIR1-	O	Dir. Signal (-),①	92	DIR2-	O	Dir. Signal (-), ②
43	OUT3+	O	Pulse signal (+), ③	93	OUT4+	O	Pulse signal (+),④
44	OUT3-	O	Pulse signal (-),③	94	OUT4-	O	Pulse signal (-),④
45	DIR3+	O	Dir. signal (+), ③	95	DIR4+	O	Dir. signal (+),④
46	DIR3-	O	Dir. signal (-), ③	96	DIR4-	O	Dir. signal (-),④
47	OUT5+	O	Pulse signal (+),⑤	97	OUT6+	O	Pulse signal (+),⑥
48	OUT5-	O	Pulse signal (-),⑤	98	OUT6-	O	Pulse signal (-),⑥
49	DIR5+	O	Dir. signal (+),⑤	99	DIR6+	O	Dir. signal (+),⑥
50	DIR5-	O	Dir. Signal (-),⑤	100	DIR6-	O	Dir. Signal (-),⑥

2.6 CN2 PIN ASSIGNMENTS: EXTERNAL POWER INPUT

CN2 Pin No	Name	Description	Cable Color
1	EXGND	Grounds of the external power.	Black
2	EX+24V	External power supply of +24V DC ± 5%	Red

Notes:

1. CN2 is a plug-in terminal connector with no screw.

2. Be sure to use the external power supply. The +24V DC is used by external input/output signal circuit.

3. Wires for connection to CN2.

   Solid wire: φ 0.32mm to φ 0.65mm (AWG28 to AWG22)

   Twisted wire:0.08mm^2 to 0.32mm^2 (AWG28 to AWG22)

   Naked wire length:10mm standard

4. The EX+24V is shorted inside PCI-8136M with COM+ in CN1 (No. 6,7,8).

5. The EXGND is shorted inside PCI-8136M with COM- in CN1 (No. 55,56).

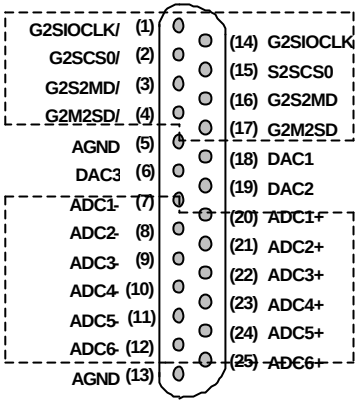
2.7 CN3 PIN ASSIGNMENTS: DB25 CONNECTOR

The signals on CN3 are for Analog input and remote serial IO.

Remote serial IO #2

Analog output

Analog input



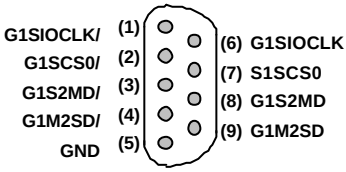
Note:

1. The DAC1~3 pins are the same with those on CN1

2. The Remote Serial IO #2 is reserved for future functions

2.8 CN4 PIN ASSIGNMENTS: DB9 CONNECTOR

The signals on CN4 are for remote serial IO#1.



3

Signal Connection

The signal connections of all the I/O signals are described in this chapter. Please refer the contents of this chapter before wiring the cable between the PCI-8136M and the motor drivers.

This chapter contains the following sections:

Section 3.1 Pulse output signals OUT and DIR

Section 3.2 Voltage output signals DAC

Section 3.3 Encoder feedback signals EA, EB and EZ

Section 3.4 Voltage input signals ADC

Section 3.5 Origin signal ORG

Section 3.6 End-Limit signals PEL and MEL

Section 3.7 Emergency stop signal ESTOP

Section 3.8 Servo on signal SVON

Section 3.9 General purpose output PRDY

Section 3.9 VCC pins

Section 3.10 Open loop and closed loop connections

3.1 Pulse output signals OUT and DIR

There are 6-axis pulse output signals on PCI-8136M. For every axis, two pairs of OUT and DIR signals are used to send the pulse train and to indicate the direction. The OUT and DIR signals can also be programmed as CW/CCW or AB phase signals pair. In this section, the electronic characteristics of the OUT and DIR signals are shown. Each signal consists of a pair of differential signals. For example, the OUT2 is consisted of OUT2+ and OUT2- signals. The following table the ping assignment for pulse output signal.

CN1 PIN No	Signal Name	Description	Axis No.
39	OUT1+	Pulse Signal (+)	1
40	OUT1-	Pulse Signal (-)	
41	DIR1+	Direction Signal (+)	
42	DIR1-	Direction Signal (-)	
89	OUT2+	Pulse Signal (+)	2
90	OUT2-	Pulse Signal (-)	
91	DIR2+	Direction Signal (+)	
92	DIR2-	Direction Signal (-)	
43	OUT3+	Pulse Signal (+)	3
44	OUT3-	Pulse Signal (-)	
45	DIR3+	Direction Signal (+)	
46	DIR3-	Direction Signal (-)	
83	OUT4+	Pulse Signal (+)	4
84	OUT4-	Pulse Signal (-)	
85	DIR4+	Direction Signal (+)	
86	DIR4-	Direction Signal (-)	
47	OUT5+	Pulse Signal (+)	5
48	OUT5-	Pulse Signal (-)	
49	DIR5+	Direction Signal (+)	
50	DIR5-	Direction Signal (-)	
97	OUT6+	Pulse Signal (+)	6
98	OUT6-	Pulse Signal (-)	
99	DIR6+	Direction Signal (+)	
100	DIR6-	Direction Signal (-)	

The output of the OUT or DIR signals are differential line driver type.

Here is the circuit of PCI-8136M pulse output (pulse generator) channels.

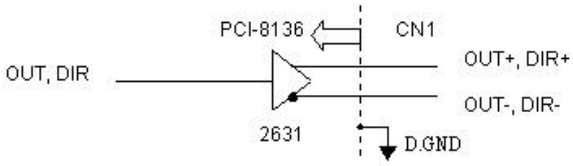


Figure 3.1.1 Pulse output (pulse generator) circuit

If the driver side is open collector mode, please use any one of positive and negative pins to be a control signal and EXGND as its output ground. Please take care that the current sink to these pins must not exceed 20mA.

3.2 Voltage output signals DAC

There are 6 DAC output channels on PCI-8136M. If the closed loop control mode is set for any one of the 6 axes, its corresponding DAC channel will be treated as voltage command output. If not, the DAC channel will be treated as a general purposed analog output channel.

The resolution of DAC is 16-bit, and the output voltage ranged from -10 V to +10V. To make correct connection, please refer to following figure:

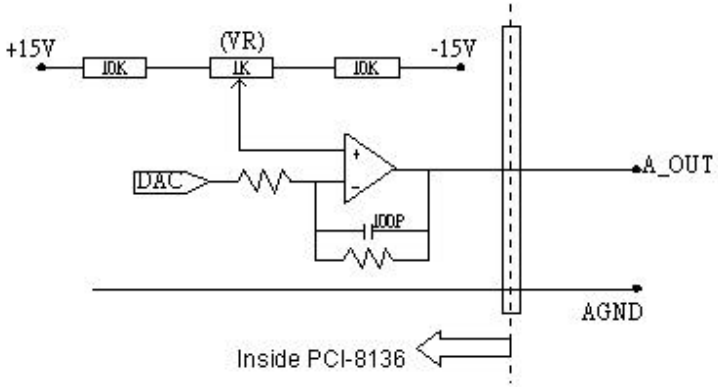


Figure 3.2.1 DAC circuit

The Analog outputs are all single ended with common ground 'AGND'. The following table is the pin assignment information for DAC.

CN1 Pin No	Signal Name	Description
2	DAC1	DAC Channel 1
3	DAC2	DAC Channel 2
4	DAC3	DAC Channel 3
52	DAC4	DAC Channel 4
53	DAC5	DAC Channel 5
54	DAC6	DAC Channel 6
1	AGND	Analog Ground
51	AGND	Analog Ground

CN3 Pin No	Signal Name	Description
18	DAC1	DAC Channel 1
19	DAC2	DAC Channel 2
6	DAC3	DAC Channel 3
5	AGND	Analog Ground
13	AGND	Analog Ground

Notice that the DAC Channel 1~ 3 in CN1 and CN3 are connected inside the PCI-8136M.

3.3 Encoder feedback signals EA, EB and EZ

The PCI-8136M provides 6 differential pulse inputs with 2500V rms isolation, and each pair of EA, EB, and EZ is related to one motion axis. The pulse mode is software programmable to be AB-phase, CW/CCW, or Pulse/Direction, and the counter speed goes up to 2 MHz. The following table is the pin assignments for encoder counters.

CN1 Pin No.	Signal Name	Description	Axis No.
21	EA1+	Encoder A-Phase (+)	1
22	EA1-	Encoder A-Phase (-)	
23	EB1+	Encoder B-Phase (+)	
24	EB1-	Encoder B-Phase (-)	
25	EZ1+	Encoder Z-Phase (+)	
26	EZ1-	Encoder Z-Phase (-)	
71	EA2+	Encoder A-Phase (+)	2
72	EA2-	Encoder A-Phase (-)	
73	EB2+	Encoder B-Phase (+)	
74	EB2-	Encoder B-Phase (-)	
75	EZ2+	Encoder Z-Phase (+)	
76	EZ2-	Encoder Z-Phase (-)	
27	EA3+	Encoder A-Phase (+)	3
28	EA3-	Encoder A-Phase (-)	
29	EB3+	Encoder B-Phase (+)	
30	EB3-	Encoder B-Phase (-)	
31	EZ3+	Encoder Z-Phase (+)	
32	EZ3-	Encoder Z-Phase (-)	
77	EA4+	Encoder A-Phase (+)	4
78	EA4-	Encoder A-Phase (-)	
79	EB4+	Encoder B-Phase (+)	
80	EB4-	Encoder B-Phase (-)	
81	EZ4+	Encoder Z-Phase (+)	
82	EZ4-	Encoder Z-Phase (-)	
33	EA5+	Encoder A-Phase (+)	5
34	EA5-	Encoder A-Phase (-)	
35	EB5+	Encoder B-Phase (+)	
36	EB5-	Encoder B-Phase (-)	
37	EZ5+	Encoder Z-Phase (+)	
38	EZ5-	Encoder Z-Phase (-)	
83	EA6+	Encoder A-Phase (+)	6
84	EA6-	Encoder A-Phase (-)	
85	EB6+	Encoder B-Phase (+)	
86	EB6-	Encoder B-Phase (-)	
87	EZ6+	Encoder Z-Phase (+)	
88	EZ6-	Encoder Z-Phase (-)	

The input circuits of the EA, EB, EZ signals are shown as follows.

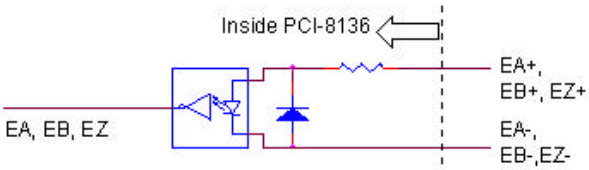


Figure 3.3.1 Pulse input (encoder counter) circuit

Note: The voltage across every differential pair of encoder input signals (EA+, EA-), (EB+, EB-) and (EZ+, EZ-) should be **at least 3.5V** or higher. Therefore, you have to take care of the driving capability when connecting with the encoder feedback or motor driver feedback.

Here are two examples of connecting the input signals with the external circuits. The input circuits can connect to the encoder or motor driver, which are equipped with: (1) differential line driver or (2) open collector output.

Connection to Line Driver Output

To drive the PCI-8136M encoder input, the driver output must provide at least 3.5V across the differential pairs with at least 6 mA driving capability. The ground level of the two sides must be tight together too.

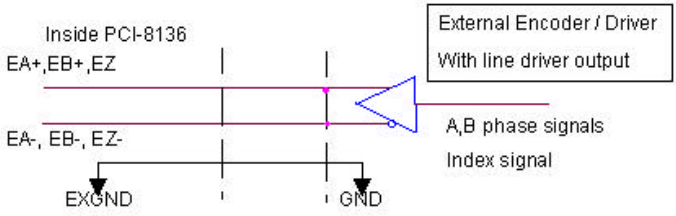
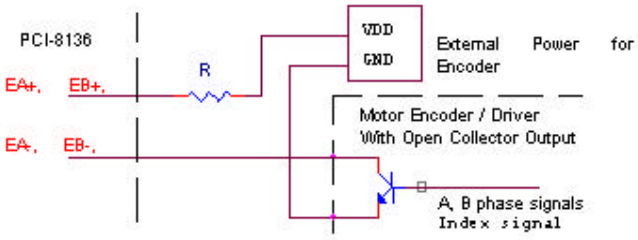


Figure 3.3.2 Connection to line driver output

Connection to Open Collector Output

To connect with open collector output, an external power supply is necessary. Some motor drivers also provide the power source. The connection between PCI-8136M, encoder, and the power supply is shown in the following diagram. Please note that the external current limit resistor R is necessary to protect the PCI-8136M input circuit. The following table lists the suggested resistor value according to the encoder power supply.

Encoder Power(VDD)	External Resistor R
+5V	0 Ω (None)
+12V	1.8kΩ
+24V	4.3kΩ



3.4 Analog Input

The PCI-8136M provides 6 12-bit A/D channels. The analog source is selectable for each channel to be±10V DC (Default) or 0~20 mA by soldering a 124O DIP resistance which is shipped with PCI-8136M.

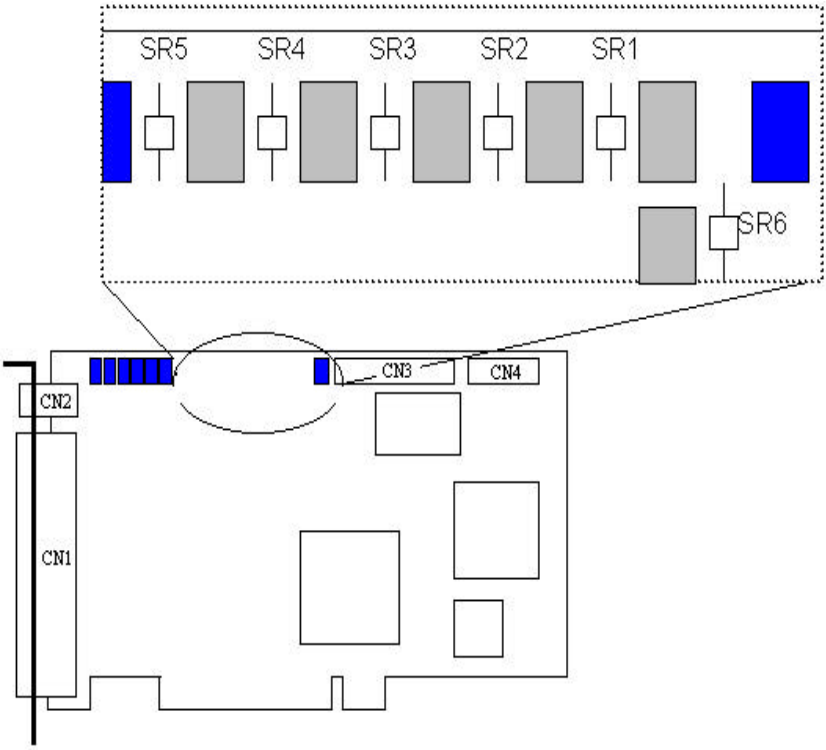


Figure 3.4.1: Current input mode – location of 124O DIP resistance

To avoid ground loops and get more accuracy measurement of A/D conversion, it is quite important to understand the signal source type. The PCI-8136M provides differential input mode that consists of two inputs each channel.

CN3 Pin No.	Signal Name	Description
20	ADC1+	ADC channel 1 (+)
7	ADC1-	ADC channel 1 (-)
21	ADC2+	ADC channel 2 (+)
8	ADC2-	ADC channel 2 (-)
22	ADC3+	ADC channel 3 (+)
9	ADC3-	ADC channel 3 (-)
23	ADC4+	ADC channel 4 (+)
10	ADC4-	ADC channel 4 (-)
24	ADC5+	ADC channel 5 (+)
11	ADC5-	ADC channel 5 (-)
25	ADC6+	ADC channel 6 (+)
12	ADC6-	ADC channel 6 (-)

A differential source means the ends of the signal are not grounded. To avoid the danger of high voltage between the local ground of signal and the ground of the PC system, a shorted ground path must be connected. Figure 3.1.2 shows the connection of differential source.

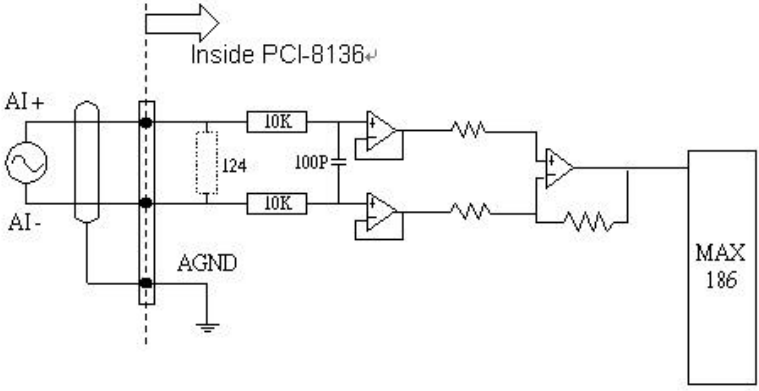


Figure 3.4.2 Analog input circuit

3.5 Origin signal ORG

The origin signals (ORG1~ORG6) are used as input signals for origin of the mechanism. The following table is the pin assignment for ORG.

CN1 Pin No.	Signal Name	Description	Alternative Name
6	COM+	Ext +24V	COM+
7	COM+	Ext +24V	COM+
8	COM+	Ext +24V	COM+
9	ORG1	Origin signal, ①	DI 1
59	ORG2	Origin signal, ②	DI 2
13	ORG3	Origin signal, ③	DI 3
63	ORG4	Origin signal, ④	DI 4
17	ORG5	Origin signal, ⑤	DI 5
63	ORG6	Origin signal, ⑥	DI 6
55	COM-	Ext Common Ground	COM-
56	COM-	Ext Common Ground	COM-

Notice that the alternative name means that if users don't use motion functions at one or more axes, the digital input will be treated as general purpose input channel.

The input circuits of the ORG signals are shown as following. Usually, a limit switch is used to indicate the origin of one axis. The specifications of the limit switches should with contact capacity of +24V, 6mA minimum. An internal filter circuit is used to filter out the high frequency spike, which may cause wrong operation.

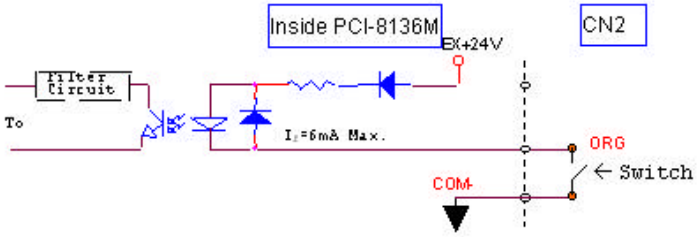


Figure 3.4.1 Connection of ORG

When the motion controller is operated at the home return mode, the ORG signal is used to stop the control output signals (OUT and DIR) a utomatically.

3.6 End-Limit signals PEL and MEL

There are two end-limit signals PEL and MEL for each axis. PEL indicates end limit signal in plus direction and MEL indicates end limit signal in minus direction. The following table is the pin assignment for EL signal.

CN1 Pin No.	Signal Name	Description	Alternative Name
6	COM+	Ext +24V	COM+
7	COM+	Ext +24V	COM+
8	COM+	Ext +24V	COM+
10	PEL1	End limit (+) ①	DI 7
11	MEL1	End limit (-) ①	DI 8
60	PEL2	End limit (+) ②	DI 9
61	MEL2	End limit (-) ②	DI 10
14	PEL3	End limit (+) ③	DI 11
15	MEL3	End limit (-) ③	DI 12
64	PEL4	End limit (+) ④	DI 13
65	MEL4	End limit (-) ④	DI 14
18	PEL5	End limit (+) ⑤	DI 15
19	MEL5	End limit (-) ⑤	DI 16
68	PEL6	End limit (+) ⑥	DI 17
69	MEL6	End limit (-) ⑥	DI 18
55	COM-	Ext Common Ground	COM-
56	COM-	Ext Common Ground	COM-

Notice that the alternative name means that if users don't use motion functions at one or more axes, the digital input will be treated as general purpose input channel.

The signal connections and relative circuit diagram are shown in the following diagram. The external limit switches features a contact capacity of +24V, 6mA minimum. You can use either 'A-type' (normal open) contact switch or 'B-type' (normal closed) contact switch by software setting.

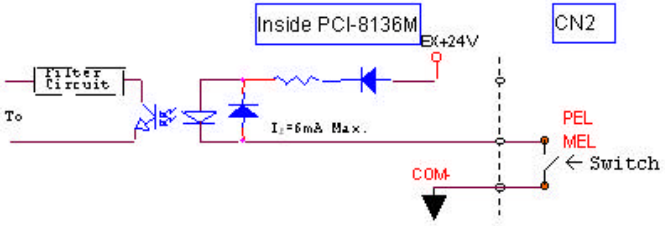


Figure 3.6.1 Connection of EL signal

3.7 Emergency stop signal ESTOP

The emergency stop signal ESTOP is used to stop pulse output from all OUT and DIR channels. The following is the ping assignment information for ESTOP.

Signal Name	CN 1 Pin No.	Description	Alternative Name
COM+	6	Ext +24V	COM+
COM+	7	Ext +24V	COM+
COM+	8	Ext +24V	COM+
ESTOP	57	Emergency stop signal	DI 19
COM-	55	Ext Common Ground	COM-
COM-	56	Ext Common Ground	COM-

Notice that the alternative name means that if users don't use motion functions at one or more axes, the digital input will be treated as general purpose input channel.

The input circuit of alarm circuit is shown in the following diagram. The external circuit must provide at least 6 mA current sink capability to drive the ESTOP signal active.

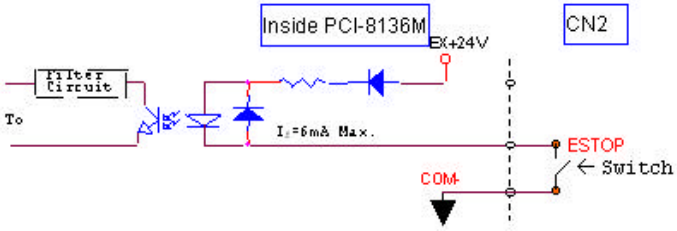


Figure 3.7.1 Connection of ESTOP

3.8 Servo on signal SVON

The SVON signals can be used as servo-on control at servo drivers or general-purpose output signals. The following is the pin assignment information for SVON.

Signal Name	CN1 Pin No.	Description	Alternative Name
COM+	6	Ext +24V	COM+
COM+	7	Ext +24V	COM+
COM+	8	Ext +24V	COM+
SVON1	12	Servo on signal ①	DO 1
SVON2	62	Servo on signal ①	DO 2
SVON3	16	Servo on signal ②	DO 3
SVON4	66	Servo on signal ②	DO 4
SVON5	20	Servo on signal ③	DO 5
SVON6	70	Servo on signal ③	DO 6
COM-	55	Ext Common Ground	COM-
COM-	56	Ext Common Ground	COM-

The output circuit of SVON signal is shown in the following diagram.

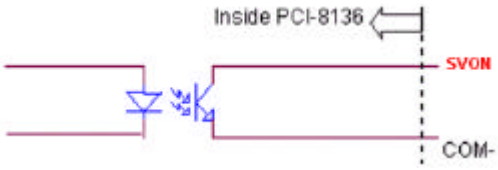


Figure 3.8.1 Connection of SVON

The SVON is open collector output with 2500V rms isolation. The maximum output switching frequency is 10 kHz, when the continuous output supply current is subject to 500mA/total, 90mA/CH(typical), and 150mA/CH(max). In power-on state, the system issues a logical '0'.

3.9 General purpose output P-RDY

There is one general purpose output pin on PCI-8136M. The pin assinment is shown as following table:

Signal Name	CN1 Pin No.	Description	Alternative Name
COM+	6	Ext +24V	COM+
COM+	7	Ext +24V	COM+
COM+	8	Ext +24V	COM+
PRDY	58	General Purpose output	DO7
COM-	55	Ext Common Ground	COM-
COM-	56	Ext Common Ground	COM-

The spec. and wiring are the same with SVON pin. Please refer to 3.8

3.10 VCC Pin

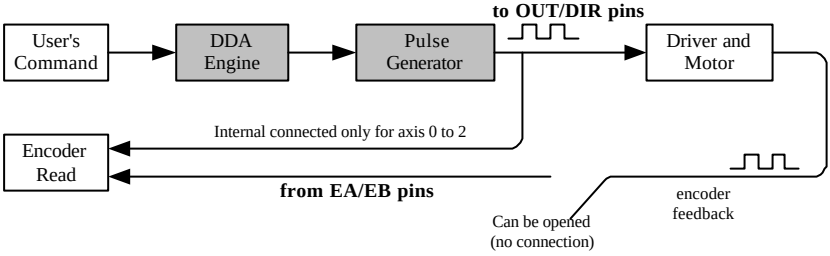
There is one pin named VCC+5V on Pin5 of CN1. This voltage source isfrom computer directly. Please don't use this voltage source on any devices which are connected to PCI-8136M's isolation I/Os. If not, the grounds will be connected both at the isolative sides and the noise will be introduced from this loop. So the isolation will be meaningless. The VCC's ground is the same with Analog's. Please be careful to deal with the noise problems.

3.11 Open Loop and Closed Loop Connection

All axes in PCI-8136M are free to set as open loop pulse output control or closed loop voltage output control. Users must realize what is the different between these two settings.

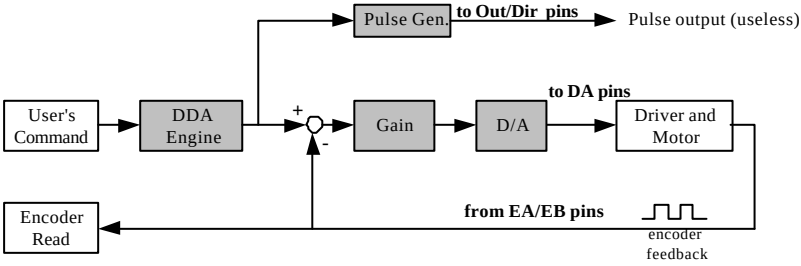
There are 6 motion control sets for every axis in PCI-8136M card. Each set has its own pulse output, encoder input, analog output, analog input and dedicated I/O channels. The block diagram of these functions are shown below:

Open Loop Control Mode (axis independent)



1. AD/DA is free to use at this mode
2. DIO is free to use at this mode if not set motion I/O active
3. Others ADPIO are free to use except this axis'
4. Encoder 0~2 are free to use if feedback loop is opened

Closed Loop Control Mode (axis independent)



1. AD is free to use at this mode
2. DIO is free to use at this mode if not set motion I/O active
3. Others ADPIO are free to use except this axis'
4. Out/Dir can't be used for other pupose

4

Operation Theorem

This chapter describes the detail operation theorem of the PCI-8136M card. Contents of the following sections are shown as following.

Section 4.1 : AD conversion and preloaded Trigger

Section 4.2 : DA Conversion

Section 4.3 : Local DIO

Section 4.4 : Pulse Input and position compare

Section 4.5 : Pulse Output

Section 4.6 : Remote serial IO

Section 4.7 : Introduction to DDA

Section 4.8 : Open loop and closed loop control

Section 4.9 : Constant velocity motion

Section 4.10 : Trapezoidal Motion

Section 4.11 : S-Curve Motion

Section 4.12 : 2D Interpolation

Section 4.13 : 3D Interpolation

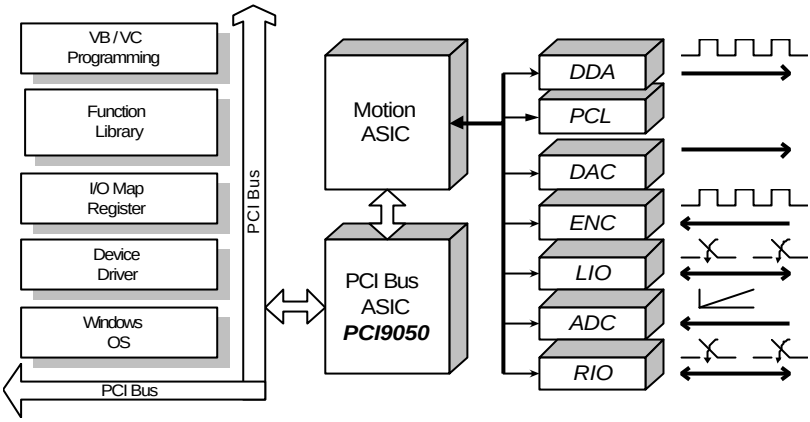
Section 4.14 : Home return mode

Section 4.15 : Motion Parameter Setting

Section 4.16 : Motion I/O

Section 4.17 : Interrupt Control

Please refer to the following architecture diagram of PCI-8136M



ADC : Please refer to section 4.1: AD Conversion and Preloaded Trigger

DAC : Please refer to section 4.2: DA Conversion

LIO : Please refer to section 4.3: DIO

ENC : Please refer to section 4.4: Pulse Input and Position Compare

RIO : Please refer to section 4.6: Remote serial IO

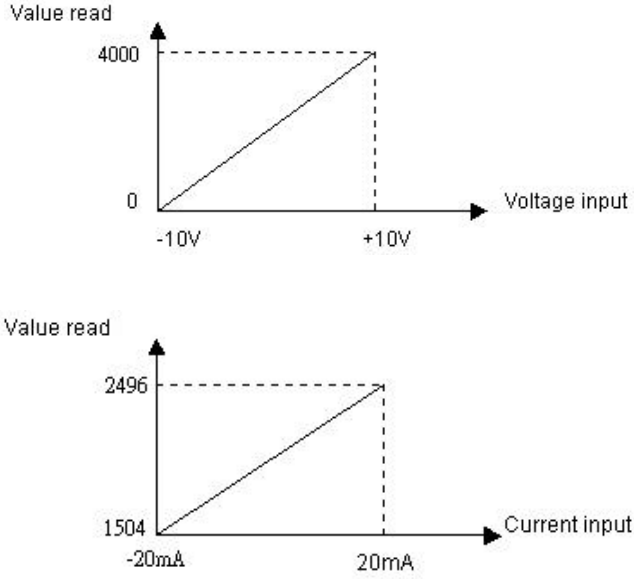
DDA : Please refer to section 4.5 and 4.7

PCL : Please refer to section 4.8

4.1 AD Conversion and Preloaded Trigger

4.1.1 ADC

The PCI-8136M provides 6 Differential ADC channels. Each channel consists of two inputs. One is for (+) signal and the other is for (-) signal. The input signal may be voltage ranged from –10 ~ +10V or current ranged from –20mA ~ 20mA. The ADC resolution is 12-bit. The following figure shows the A (voltage or current) to D (value read) converting table. The zero voltage or current is at value 2000.



Related functions:

```
_8136_A_Initial(): please refer to section 5.2
_8136_A_Read_Value(), _8136_A_Read_Volt(): please refer to
section 5.7
```

4.1.2 Voltage Compare

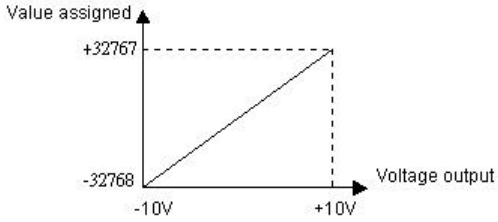
The voltage compare function of PCI-8136 is very useful. It allows us er to set a compare value by software function. When one ADC signal reaches the pre-set value, an interrupt will be generated for corresponding channel.

Relative functions:

```
_8136_A_Set_Compare_Value(), _8136_A_Set_Compare_Volt (),
_8136_S_Set_Int_Factor() : please refer to section 5,9
```

4.2 DA Conversion

The PCI-8136M provides 6 channel 16-bit, bipolar (±10V DC) digital to analog converter. The D (value assigned) to A (voltage output) converting table is showed bellow.



4.2.1 DA Output by Trigger Source

PCI-8136 allows users to set a pre-load value for each DAC channel. The value will be sent once any trigger condition for this channel is happened. The trigger source could be from encoder counter comparators or ADCs by setting the trigger map in the software functions. Users can set every channel's trigger sources independently. The compare method could be set in Set_Int_Factor() function.

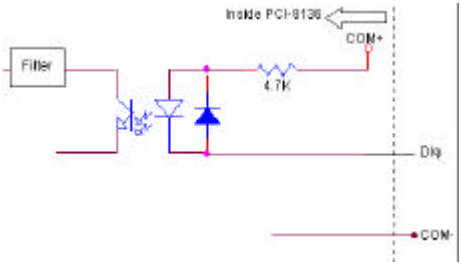
Related functions:

```
_8136_A_Initial() : please refer to section 5.2
_8136_A_Write_Value(), _8136_A_Write_Volt(),
_8136_A_Output_Control() : please refer to section 5.7
_8136_A_Set_Preload_Volt(), _8136_A_Set_Trigger(),
_8136_A_Set_Trigger_Map() : please refer to section 5.7
_8136_S_Set_Int_Factor() : please refer to section 5,9
```

4.3 Local DIO

4.3.1 Digital Input

The PCI-8136M provides 19 digital input channels with 2500rms isolation. The DI channel is logically “HIGH” when no current goes from COM+ to DIf , and, Logically “LOW” when current goes from COM+ to DIf. The max current passing trough DIf must be less than 20mA..

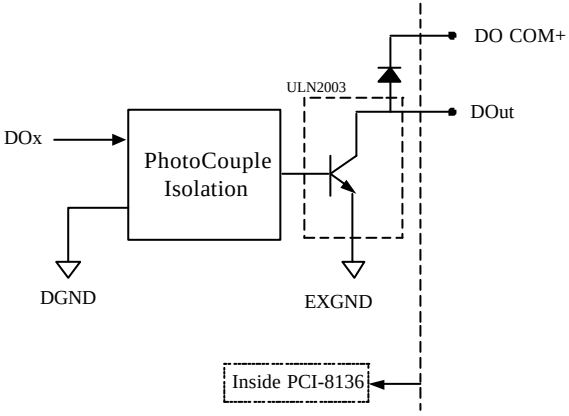


Related functions:

`_8136_D_Input(), _8136_D_InputA() : please refer to section 5.5`

4.3.2 Digital Output

The PCI-8136M provides 7 open collector output channels with 2500rms isolation. Please carefully refer to section 3.7,3.8 for the circuit wiring.



Related functions:

`_8136_D_Output(), _8136_D_OutputA() : please refer to section 5.5`

4.4 Pulse Input and Position Compare

4.4.1 Pulse Input

The PCI-8136M has 6 32-bit pulse input channels for encoder counter. It can accept 3 kinds of pulse input:

1. Plus and minus pulses input (CW/CCW mode).

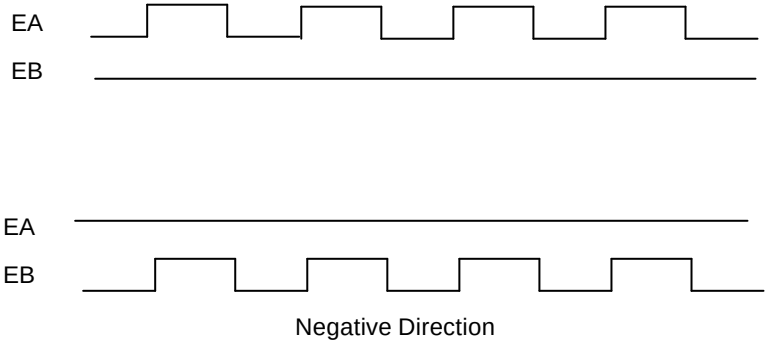
2. 90°phase difference signals(AB phase mode).

3. Pulse and direction input(Pulse/DIR).

90°phase difference signals may be selected to be multiplied by a factor of 1,2 or 4x AB phase mode is the most commonly used for incremental encoder input. For example, if a rotary encoder has 2000 pulses per phase (A or B phase), then the value read from the counter will be 8000 pulses per turn or –8000 pulses per turn depends on its turning direction. These input modes can be selected by software function call.

Plus and Minus Pulses Input Mode (CW/CCW Mode)

In this mode, pulse from EA causes the counter to count up, whereas EB caused the counter to count down.

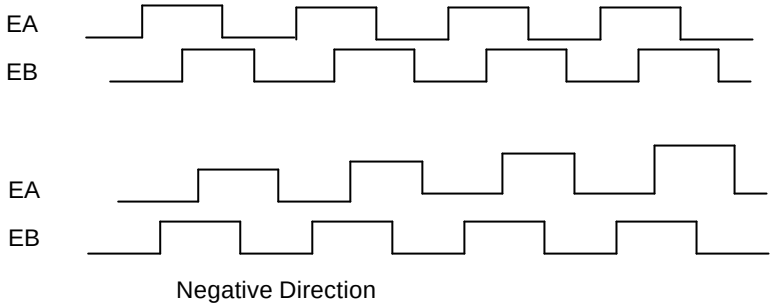


Negative Direction

90° phase difference signals Input Mode(AB phase Mode)

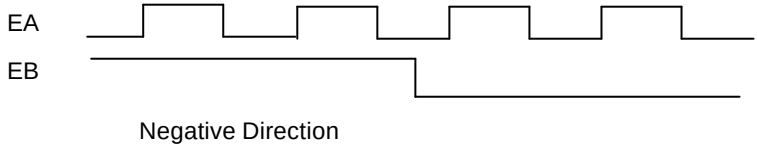
In this mode, the EA signal is 90° phase leading or lagging in comparison with EB signal. Where “lead” or “lag' of phase difference between two signals is caused by the turning direction of motors. The up/down counter counts up when the phase of EA signal leads the phase of EB signal.

The following diagram shows the waveform.



pulse and direction input(Pulse/DIR)

In this mode, the high / low status of EB decides the counter value to increase or decrease (Direction), whereas EA decide the count number (Pulse).



4.4.2 Position Counter Value Capture (Latch)

The EZ (index signal) of each pulse input channel doesn't affect counter value. It can capture (latch) current counter value by proper setting, and generates an interrupt signal when receiving a rising edge. The counter value capture function is very useful to sensing position of a moving object.

Related functions:

_8136_P_Initial() : please refer to section 5.2 _8136_P_Set_Input_Type(), _8136_P_Read(), _8136_P_Clear(), _8136_P_Set_Index_Latch(), _8136_P_Read_Index(), _8136_P_Read_Latch_Value(): please refer to section 5.8

4.4.3 Position Compare

The PCI-8136M provides position compare function for all six pulse input channels. Once the counter value is reached the pre-set compare value, an interrupt signal will be generated immediately. This function can effectively reduce the overhead of CPU's polling for current position.

Related functions:

```
_8136_S_Set_Int_Factor() : please refer to section 5,9
_8136_P_Set_Compare_Value(): please refer to section 5.8
```

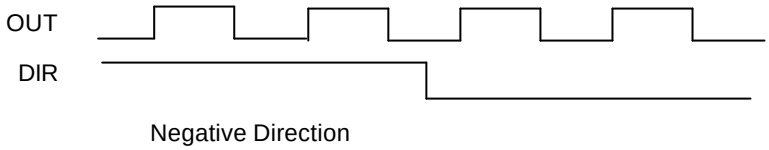
4.5 Pulse Output

The PCI-8136M provides 6 pulse output channels. They are used to send out constant-frequency pulse trains. When changing the output frequency of any channel, there is at most 265ms time delay.

There are also 3 kinds of pulse output: (1). plus and minus pulses input(CW/CCW mode); (2) pulse and direction input(Pulse/DIR); (3). 90° phase difference signals(AB phase mode);

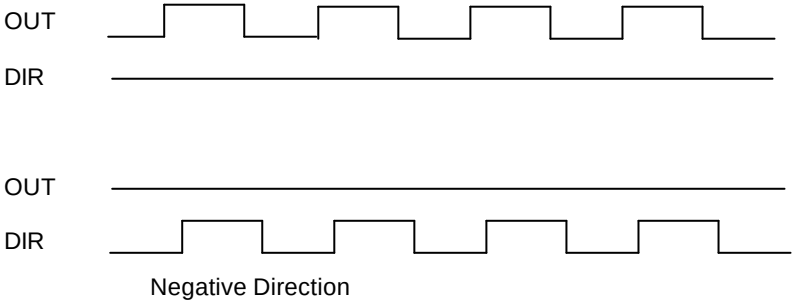
pulse and direction output (Pulse/DIR)

In this mode, the high/low status of DIR defines the plus/negative direction, whereas OUT generates the pulse train.



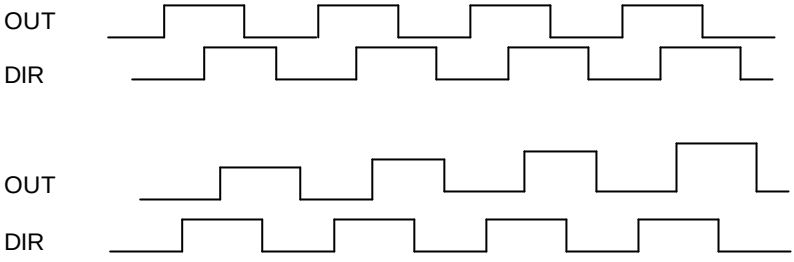
Plus and Minus Pulses Output Mode(CW/CCW Mode)

In this mode, plus frequency (plus direction) goes on OUT, whereas negative frequency (negative direction) is generated from DIR.



90° phase difference signals Output Mode(AB phase Mode)

In this mode, the OUT signal is 90° phase leading or lagging in comparison with DIR signal. Where “lead” or “lag' of phase difference between two signals is caused by the direction of pulse train.



Negative Direction

Related functions:

```
_8136_P_Initial() : please refer to section 5.2
_8136_P_Set_Output_Type(), _8136_P_Send(), _8136_P_Stop(),
_8136_P_Change_Speed(), please refer to section 5.2
```

4.6 Remote Serial IO

The PCI-8136M support 2 set of remote serial IO, each set may consist at most 64DI and 64DO. To use remote serial IO function, a slave module is needed.

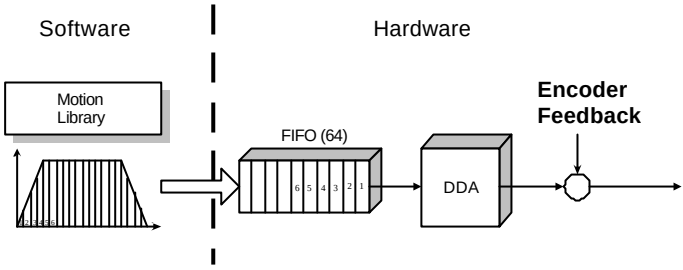
Note: The remote I/O functions are reserved on current version.

Related functions:

```
_8136_R_Initial() : please refer to section 5.2
_8136_R_Status(), _8136_R_Write(), _8136_R_Read() : please
refer to section 5.6
```

4.7 Introduction to DDA

This section will introduce the DDA operating theorem that creates all those various motion function. The DDA is for Digital Differential Analyze. It is a method to accomplish motion control under non-realtime OS.



Refer to above figure, the software (Motion Library) solve motion command and generate a string of displacement data. Each data indicates quantity of pulse in 4ms(default).

For example: The trapezoidal curve at above figure represents a motion command that last 1 sec. The Motion Library solves this command and generates a string of displacement data. {10, 20, 30, … , 470, 480, 490, 500, …. 500, 490,480,…., 300,200,100} The total number of data is 1000ms / 4ms = 250.Data

The data is transmitted via PCI-Bus into FIFO in PCI-8136M. The size of FIFO is 64 for each axis. Every 4ms or less, the DDA engine takes a data from FIFO and send these pulses to motor driver with equal time interval.

The DDA engine is in charge of generate pulse in a smooth way. If DDA takes a data of 500 from FIFO, it generates a pulse every 8μs in the following 4ms. Its means that the DDA engine will divide the total cycle time to send the total pulse counts with equal time interval. Every 4ms or less cycle time, the DDA take another data from FIFO and repeats the same operation.

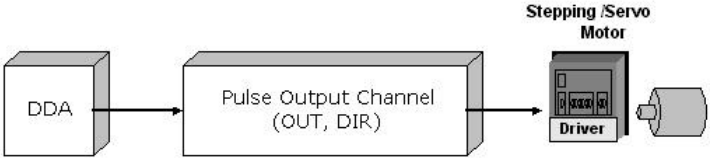
Why does DDA help to accomplish motion control under non-realtime OS? The key reason is that all displacement data in FIFO is pre-calculated by software when CPU is leisure, and DDA get data from FIFO, which is always non-empty.

4.8 Open-loop and close-loop control

This section explains the motion control algorithms provided by PCI-8136M. There are two possible ways of control command output. One is via DAC channel → analog voltage, and the other is via OUT & DIR→ Pulse command.

4.8.1 Open-loop control

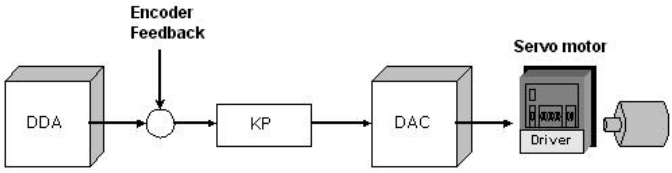
When the OUT & DIR channel is used as motion command output, the block diagram is as the following figure.



The pulse generated by DDA engine is directed into pulse output device. And, according to user's choice of pulse type, CW/CCW, Pulse/Direction, or AB phase, pulses chains will generated from OUT & DIR channels.

4.8.2 Close-loop control

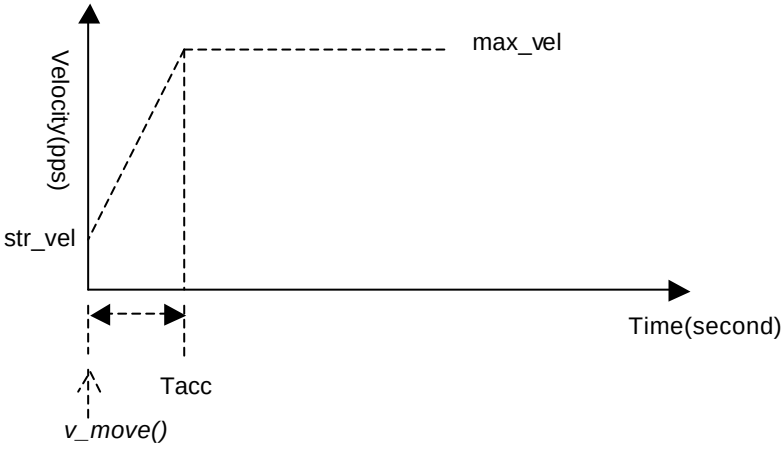
When the DAC channel is selected as motion command output, the block diagram is as following figure.



In this mode, the pulse output channel OUT & DIR is disabled, and won't generate any pulse signals. The DAC output value is decided by position error multiplied by Kp gain. Position error is calculated by accumulating DDA pulses and subtracting encoder feedback. The Kp gain is tunable by using software function call. This procedure is done by hardware and is always much faster than mechanical responding. However, the reasonable Kp value depends on specific application very much. Some try and error procedures may be needed.

4.9 Constant Velocity Motion

This mode is used to operate one axis motor at constant velocity motion. The output pulse accelerates from a starting velocity (str_vel) to the specified constant velocity (max_vel). The ***_8136_*v_move()** function is used to accelerate constantly while the ***_8136_*sv_move()** function is to accelerate according to S-curve (constant jerk). The pulse output rate will keep at maximum velocity until stop function is issued. The ***_8136_*motion_*stop()** function is used to stop the velocity to zero (stop). The following graph is the trapezoidal velocity profile for v_move() function.



Relative Functions:

_8136_v_move( ), _8136_motion_stop( ), _8132_sv_move(): Refer to section 5.5

4.10 Trapezoidal Motion

This mode is used to move one or more axes to a specified position (or distance) with a trapezoidal velocity profile. Single axis and multi-axes are controlled from point to point or follow a specific path like ARC. An absolute or relative motion can be performed. In absolute mode, the target position is assigned. In relative mode, the target displacement is assigned. In both absolute and relative mode, the acceleration and the deceleration time in seconds can be different. The **_8136_motion_status()** function is used to check whether the movement is complete(the pulse command is all sent). The following diagram shows the trapezoidal profile. The target position or distance must be given in the unit of pulse.

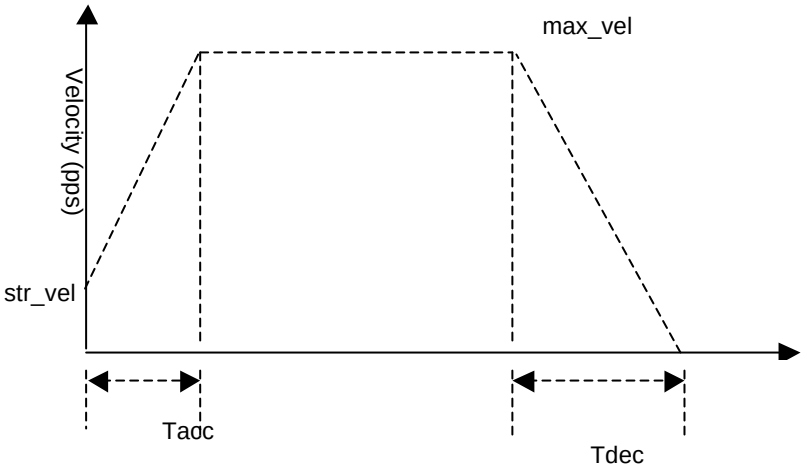
The physical length or angle of one movement is dependent on the motor driver and the mechanism (includes the motor). Since absolute move mode needs the information of current actual position, so “External encoder feedback (EA, EB pins)” must be connected or the feedback source must be assigned in **_8136_M_set_Feedback()** function if you don't have encoder on axis0 to 2. You can assign the feedback source to be the command pulses only if you are using axis0 to 2. Otherwise, you must connect a encoder feedback signal on that axis. An example for PTP motion function is as follows:

```
_8136_Start_TR_Move(CardNo, Distance, str_vel, max_vel, Tacc,
Tdec)
```

There are some similar parameters in all motion functions. The str_vel and max_vel parameters are given in the unit of pulse per second (pps). The Tacc and Tdec parameters are given in the unit of seconds. They represent accel./decel time respectively. You have to know the physical meaning of “one movement” to calculate the physical value of the relative velocity or acceleration parameters. The following formula gives the basic relationship between these parameters.

```
            max_vel = str_vel + accel*Tacc;
0=max_vel+decel*Tdec
```

where accel/decel represents the acceleration/deceleration rate in unit of pps/sec. The area inside the trapezoidal profile represents the moving distance.



Relative Functions:

```
_8136_P_Initial() refer to section 5.2
_8136_Motion_Stop() refer to section 5.18
_8136_Motion_Status() refer to section 5.12
_8136_Start_TR_Move(),_8136_Start_TA_Move() refer to section
5.13
```

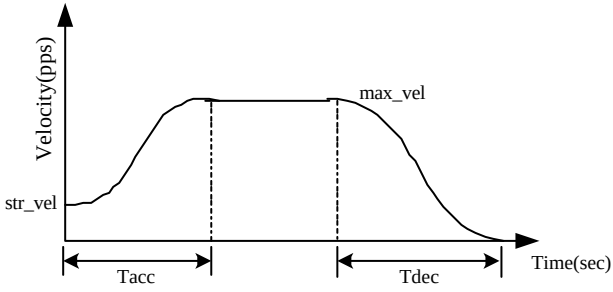
4.11 S-Curve Profile Motion

This mode is used to move one axis motor to a specified position (or distance) with a S-curve velocity profile. S-curve acceleration profiles are useful for both steppers and servo motors. The smooth transitions between the start of the acceleration ramp and the transition to the constant velocity produce less wear and tear than a trapezoidal profile motion. The smoother performance increases the life of the motors and mechanics of a system.

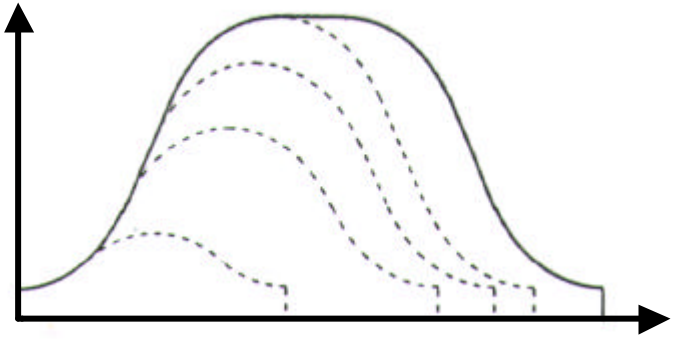
Single axis and multi-axes are controlled from point to point or follow a specific path like ARC. An absolute or relative motion can be performed. In absolute mode, the target position is assigned. In relative mode, the target displacement is assigned. In both absolute and relative mode, the acceleration and the deceleration time in seconds can be different. The **_8136_motion_status()** function is used to check whether the movement is complete(the pulse command is all sent). The following diagram shows the trapezoidal profile. The target position or distance must be given in the unit of pulse.

The physical length or angle of one movement is dependent on the motor driver and the mechanism (includes the motor). Since absolute move mode needs the information of current actual position, so “External encoder feedback (EA, EB pins)” must be connected or the feedback source must be assigned in **_8136_M_set_Feedback()** function if you don't have encoder on axis0 to 2. You can assign the feedback source to be the command pulses only if you are using axis0 to 2. Otherwise, you must connect an encoder feedback signal on that axis.

These are some similar parameters in all motion functions. The str_vel and max_vel parameters are given in the unit of pulse per second (pps). The Tacc and Tdec parameters are given in the unit of seconds. They represent accel./decel time respectively. You have to know the physical meaning of “one movement” to calculate the physical value of the relative velocity or acceleration parameters. The following diagram shows the meaning of these parameters.



The S-curve profile motion functions are designed to always produce smooth motion. If the time for S-Curve acceleration parameters combined with the final position don't allow an axis to reach the maximum velocity(i.e.: the moving distance is too small to reach maximum velocity), the maximum velocity is automatically lowered and recalculated the deceleration time. The trapezoidal motion also has these characteristics but its shape is like a triangle.

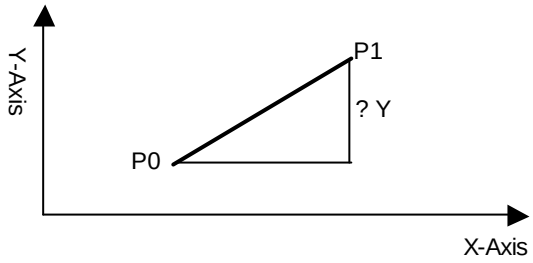


Relative Functions:

```
_8136_P_Initial() refer to section 5.2
_8136_Motion_Stop() refer to section 5.18
_8136_Motion_Status() refer to section 5.12
_8136_Start_SR_Move(),_8136_Start_SA_Move() refer to section
5.13
```

4.12 2D Interpolation

"Interpolation between two axes" means the two axes start simultaneously and reach their ending points at the same time. For example, in the figure below, we want to move the axes from P0 to P1, and hope the two axes start and stop simultaneously at a period of time ?t. Then the moving speed along X-axis and Y-axis will be?X/?t., ?Y/?t, respectively.



The interpolation function of PCI-8136M has similar format. For example, a S-Curve 2-axis (2 and 3) linear interpolation:

```
int16 AxisArray[2]={2,3}

_8136_Start_S_Move_XY(CardNo, AxisArray, Px, Py, Start_V,
Max_V,Tacc,Tdec)
```

The first axis at the axis array of interpolation functions is the main axis, and the other axis is the secondary axis. The speed relation between main and secondary axes is as follows:

Composite Speed = Speed of main axis x

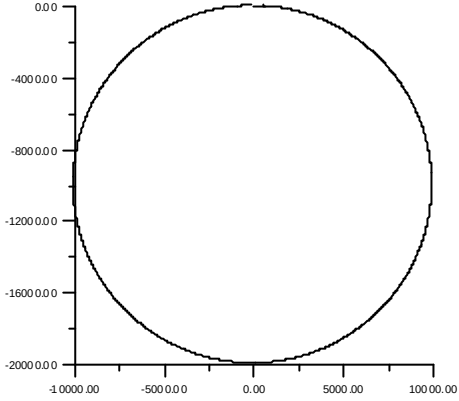
$$\frac{\sqrt{(\text{Set number of pulses for main axis})^2 + (\text{Set number of pulses for slave axis})^2}}{\text{Set number of pulses for main axis}}$$

$$\text{or} = \text{Speed of main axis} \times \sqrt{1+\left(\frac{\text{Set number of pulses for slave axis}}{\text{Set number of pulses for main axis}}\right)^2}$$

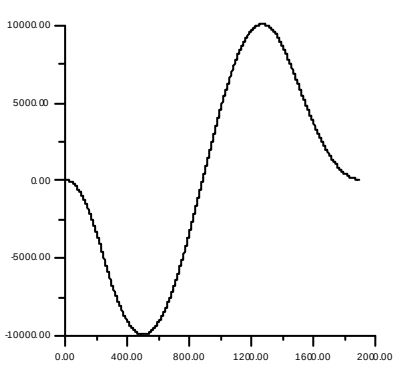
The composite speed profile could be trapezoidal or s-curve velocity profile during one interpolation motion. The following graph is the result of trapezoidal circular interpolation. The command for this result is:

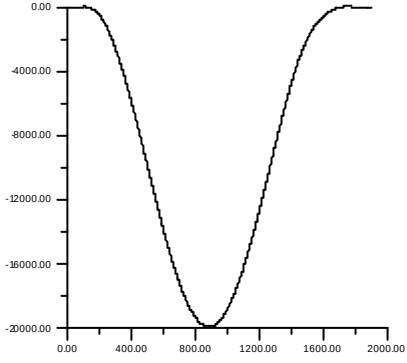
```
int16 AxisArray[2]={2,3}
            Start_Arc_XY(CARD0, AxisArray, 0, -10000, 360.0,
100, 10000, 1.0, 2.0)
```

The third and fourth parameters represent the arc center. The fifth parameter means total arc angle.



The position of Axis 1 & Axis 2 are shown as followings





Relative Functions:

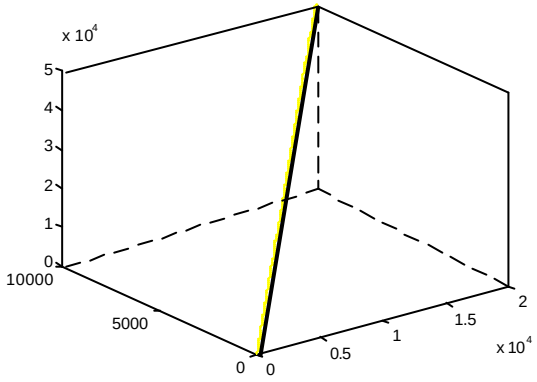
```
_8136_P_Initial() refer to section 5.2
_8136_Motion_Stop() refer to section 5.18
_8136_Motion_Status() refer to section 5.12
_8136_Start_Move_XY(),_8136_Start_S_Move_XY(),
_8136_Start_Arc_XY(),_8136_Start_S_Arc_XY() : Refer to section
5.14
```

4.13 3D Interpolation

The PCI-8136M supports three axes linear interpolation. Users can choose any three axes from 6 axes to fulfill it. The composite speed calculation is the same with 2D interpolation. Also, Trapezoidal and S-curve speed profile are selectable. The following graph is the result of 3 axes linear interpolation. The command line of the result is:

```
int16 AxisArray[3]={2,3,4}
        Start_Move_XYZ(CARD0,AxisArray,20000,10000,5000
0,100,30000,0.01,0.1);
```

Parameters 3 to 5 means the absolute position of the next 3D point.



Relative Functions:

```
_8136_P_Initial() refer to section 5.2
_8136_Motion_Stop() refer to section 5.18
_8136_Motion_Status() refer to section 5.12
_8136_Start_Move_XYZ(),_8136_Start_S_Move_XYZ() refer to
section 5.15
```

4.14 Home Return Mode

In most applications, home point is a very important reference to the coordinate of space. The PCI-8136M has a simple way to search a home point which is connected to the ORG pin of CN1. After giving a home moving command, the axis will start to move toward one direction until the ORG signal is reached. Once the ORG is triggered, the axis will stop immediately and clear the encoder counter.

The example of homing function is as follows:

```
_8136_Home_Move(CardNo, AxisNo, Str_V, Max_V, Tacc)
```

The Str_V and Max_V's value decide the searching direction of homing.

Relative Functions:

```
_8136_P_Initial() refer to section 5.2
_8136_Motion_Stop() refer to section 5.18
_8136_Home_Move() refer to section 5.17
```

4.15 Motion Parameters Setting

The default setting of output pulse width for PCI-8136M is 2 micro seconds and the control loop cycle time is 4.096ms. The setting could be changed by M_Set_Sytem_Param() function according to the following table.

MAX Speed	32K	64K	128K	256K	512K	1024K
Pulse Width	32µs	16µs	8µs	4µs	2µs	1µs
Control Loop Cycle Time	32.768ms	16.384ms	8.192ms	4.096ms	2.048ms 4.096ms (default)	1.024ms 2.048ms 4.096ms

If the stepping motor or pulse type servo driver is used, the pulse width and maximum motor speed must be set properly. If a voltage command servo driver is used, the loop cycle time could be set higher as fast as the computer is capable to run. If the system becomes unstable, please return to the default setting.

Relative Functions:

`_8136_M_Set_System_Param()` refer to section 5.11

4.16 The Motion IO Interface

There are 19 general purpose digital input and 7 digital output channels on PCI-8136M. If users use M_Set_IO_Active() to enable 19 input digital I/Os for motion purpose, the axis will stop when it reach these signals. If not, these input channels are just the general purpose input points.

4.16.1 SERVO ON

Most servo drivers receive one signal for activating themselves to control motors. The SVON signal of PCI-8136M is designed for this purpose. The SVON signals are controlled by software function: **_8136_*M*_Set_SVON()**..

4.16.2 Limit Switch Signal

In any operation mode, if an ±EL signal is active during moving condition, it will cause PCI-8136M to stop the control output signals (OUT and DIR). PEL signal indicates end-limit in positive (plus) direction. MEL signal indicates end-limit in negative (minus) direction. When the output pulse signals (OUT and DIR) are toward positive direction, the pulse train will be immediately stopped when the PEL signal is inserted, while the MEL signal is meaningless in this case, and vise versa. When the PEL is inserted and the output pulse is fully stop, only the negative (minus) direction output pulse can be generated for moving the motor to negative (minus) direction.

The end-limit signals can be used to generate the IRQ by setting the bit 0 of INT factor in software function: **_8136_S_Set_Int_Factor()**.

The signal status can be monitored by software function: **_8136_M_PEL_Status()**, **_8136_M_MEL_Status()**

4.16.3 ORG

When the PCI-8136M is operated at the home return mode, the ORG signal is used to stop the control output signals (OUT and DIR).

The ORG signal can also generate INT signal by setting the bit 2 of interrupt factor) in software function: **_8136_S_Set_Int_Factor().**

4.16.4 Emergency stop signal (ESTOP)

The PCI-8136M provide a ESTOP signal for emergency stop. This input channel is for stopping all PCI-8136M output pulses for emergency situation is occurred if you set the function **_8136_M_Set_IO_Active()**.

Relative Functions:

```
_8136_M_Set_IO_Active(), refer to section 5.11
_8136_M_ORG_Status(), _8136_M_PEL_Status(),
_8136_M_MEL_Status(), _8136_M_ALM_Status(), refer to section
5.12
```

4.17 Interrupt Control

The PCI-8136M can generate INT signal to host PC according to 8 types of interrupt factors, refer to **_8136_S_Set_Int_factor()** function for more details. The following table represents the interrupt setting for all factors.

_8136_S_Set_Int_factor(Cardno, AxisNo, Int_Factor)

AxisNo / Int. Factor bit (type)	0	1	2	3	4	5
0	EL1	EL2	EL3	EL4	EL5	EL6
1	ALM					
2	ORG1	ORG2	ORG3	ORG4	ORG5	ORG6
3	EZ1	EZ2	EZ3	EZ4	EZ5	EZ6
4	CMP1	CMP2	CMP3	CMP4	CMP5	CMP6
5	Timer	-	-	-	-	-
6	ADC1	ADC2	ADC3	ADC4	ADC5	ADC6
7	INP1	INP2	INP3	-	-	-

Note: EL is both PEL and MEL, EZ is index signal , CMP is position compare true, Timer is card's internal timer, ADC is analog compare true. INP is motion command finished.

For each axis number, the interrupt can be set according to this table.

Because users can't deal with interrupt under Windows System. PCI-8136M has another way for user to receive interrupts. That is Windows message system. This card uses events to notice user's program if interrupt is coming. Users can create a thread to get the interrupt events and then use **_8136_S_Get_Int_Status()** to get the interrupt status. The status bits for each axis is in the following table:

_8136_S_Get_Int_Status(Cardno, AxisNo, Status)

Bits	Description
0	Positive limit switch interrupt
1	Negative limit switch interrupt
2	Alarm pin interrupt
3	ORG pins interrupt
4	Index signal interrupt
5	Position counter compare interrupt
6	Internal timer interrupt
7	Analog compared interrupt
8	Motion command finished

Use Thread to deal with Interrupt under Windows NT/95

In order to detect the interrupt signal from PCI-8136M under Windows NT/95, user must create a thread routine first. Then use APIs provided by PCI-8136M to get the interrupt signal. Each card has 7 events for these interrupts. Event 0 ~ 5 stands for axis 0~5 and event 6 stands for timer interrupt and alarm interrupt. The sample program is as follows:

Situatuins: Assume that we have one card and want to receive Timer interrupt.

Steps:

1. Define a Global Value to deal with interrupt event

```
HANDLE hEvent[7];
volatile bool ThreadOn;
```

2. In Initializing Section (you must Initialize PCI-8136M properly first), set interrupt types and enable an event for each axis.

```
_8136_S_Set_Int_Factor(0,0, 0x40);
_8136_S_INT_Control(0,1);
_8136_INT_Enable(0,&hEvent[0]);
```

_8136_INT_Enable function.

Note: For each card, you must assign a 7-events-array in.

---

3. Define a Global Function (Thread Body). Use WaitForSingleObject() or WaitForMultipleObjects() to wait events. Remenber to reset this event after you get the event.

```
UINT IntThreadProc(LPVOID pParam)
{
 U32 IntSts;
 while(ThreadOn==TRUE)
 {
  ::WaitForSingleObject(hEvent[6],INFINITE);
  _8136_S_Get_Int_status(0,0,&IntSts);
  ::ResetEvent(hEvent[6]);
 }
 return 0;
}
```

4. Start the thread(Use a boolean value to control the thread's life)

   ```
   ThreadOn=TRUE;
   AfxBeginThread(IntThreadProc,GetSafeHwnd(),THREAD_PRIORITY_NORMAL);
   ```

5. Before exit the program, remember to let the thread go to end naturally.

   ```
   ThreadOn=FALSE;
   ```

We suggest user to create a thread and use WaitForSingleObject() for each events in order to guarantee the performance.

You can also use _8136_Callback_Function() to receive INT event and ignore the above method but the interrupt service routine in this function should be programmed carefully. The total spent time in this call back function should not be too long.

Relative Functions:

`_8136_INT_Enable(), _8136_INT_Disable(), _8136_S_Set_Int_Factor(), _8136_S_INT_Control(), _8136_S_Get_Int_Status(), _8136_Callback_Function()` refer to section 5.9

5

Motion Library

This chapter describes the supporting software for PCI-8136M cards. User can use these functions to develop application program in C or Visual Basic or C++ language.

The function prototypes and some common data types are decelerated in **PCI-8136M.H**. These data types are used by PCI-8136M library. We suggest you to use these data types in your application programs. The following table shows the data type names and their range.

Type Name	Description	Range
U8	8-bit ASCII character	0 to 255
I16	16-bit signed integer	-32768 to 32767
U16	16-bit unsigned integer	0 to 65535
I32	32-bit signed long integer	-2147483648 to 2147483647
U32	32-bit unsigned long integer	0 to 4294967295
F32	32-bit single-precision floating-point	-3.402823E38 to 3.402823E38
F64	64-bit double-precision floating-point	-1.797683134862315E308 to 1.797683134862315E309
Boolean	Boolean logic value	TRUE, FALSE

The functions of PCI-8136's software drivers use full-names to represent the functions' real meaning. The naming convention rules are:

In C Environment :

_{hardware_model}_{action_name}. e.g. **_8136_Initial()**.

In order to recognize the difference between C/C++ library and Visual Basic library, A capital "B" is put on the head of each function name of the Visual Basic function. e.g. **B_8136_Initial().**

5.1 List of Functions

Initialization	***Section 5.2***
_8136_Initial(*cardno)	Interface card initialization
_8136_S_Close(cardno)	Interface card close
_8136_A_Initial(cardno)	Analog I/O initialization
_8136_P_Initial(cardno)	Pulse I/O initialization

System Parameters	***Section 5.3***
_8136_R_Set_RIO_Clk(cardno, slaveno, clk)	Set Rio clock divider
_8136_A_Set_DAC_Clk(cardno,clk)	Set DAC clock divider
_8136_A_Set_ADC_Clk(cardno,clk)	Set ADC clock divider
_8136_S_Set_Timer_Value(cardno,timer)	Set Timer click count
_8136_P_Set_Enc_Filter(cardno,filter)	Set encoder filter clock

Card Information	***Section 5.4***
_8136_S_Get_IRQ_Channel(cardno, *irq)	Get I/O card's IRQ
_8136_S_Get_Base_Addr(cardno, *base)	Get I/O card's base address

Digital I/O	***Section 5.5***
_8136_D_Output(cardno, ch, value)	Digital output for one bit
_8136_D_Input(cardno, ch, *value)	Digital input for one bit
_8136_D_OutputA(cardno, value)	Digital Output for all bits once
_8136_D_InputA(cardno, *value)	Digital Input for all bits once

Remote I/O	***Section 5.6***
_8136_R_Status(cardno, slaveno)	Check Remote I/O Status
_8136_R_Write(cardno, slave, set, value)	Write a word to remote
_8136_R_Read(cardno, slave, set, *value)	Read a word from remote

Analog I/O	***Section 5.7***
_8136_A_Write_Value(cardno, ch, value)	Output DAC in value
_8136_A_Write_Volt(cardno, ch, value)	Output DAC in voltage
_8136_A_Read_Value(cardno, ch, *value)	Input from ADC in value
_8136_A_Read_Volt(cardno, ch, *volt)	Input from ADC in voltage
_8136_A_Output_Control(cardno, ch, ctrl)	Start or stop DAC output
_8136_A_Set_Trigger(cardno, ch, ctrl)	Set DAC output by trigger
_8136_A_Set_Trigger_Map(cardno, ch, src)	Select DAC trigger source
_8136_A_Set_Preload_Volt(cardno,ch ,volt)	Set DAC trigger output voltage
_8136_A_Set_Compare_Value(card,ch,value)	Set ADC compare value
_8136_A_Set_Compare_Volt(card,ch,value)	Set ADC compare voltage

Pulse I/O	***Section 5.8***
_8136_P_Set_Output_Type(card, enc, fmt)	Set pulse output mode
_8136_P_Set_Input_Type(card, enc, fmt, mul)	Set pulse input mode
_8136_P_Read(card, enc, *data)	Read encoder counter
_8136_P_Clear(card, enc)	Clear encoder counter
_8136_P_Send(card, enc, frequency)	Send a constant pulse train
_8136_P_Stop(card, enc);	Stop pulse train
_8136_P_Change_Speed(card, enc, freq)	Change pulse train frequency
_8136_P_Read_Index(card, enc, *index)	Read index value
_8136_P_Set_Index_Latch(card, enc, type)	Set index latch type
_8136_P_Read_Latch_Value(card, enc, *data)	Read a latched encoder data
_8136_P_Set_Compare_Value(card, enc, dta)	Set a encoder compare data

Interrupt Conrol	***Section 5.9***
_8136_INT_Enable(cardno, *event)	Set interrupt event handler

_8136_INT_Disable(cardno)	Remove int. event handler
_8136_S_Set_Int_Factor(cardno, ax,factor,op)	Set interrupt factor
_8136_S_INT_Control(cardno, ctrl)	Enable/disable interrupt
_8136_S_Get_Int_Status(cardno, ch, *status)	Get Int. status
_8136_Callback_Function(cardno, *callbkfn)	Set a call back function for int.

Closed Loop Initialization	***Section 5.10***
_8136_C_Initial(cardno,axisno)	Close loop control initialization

Motion Parameters	***Section 5.11***
_8136_M_Set_System_Param(cardno,spd,tm)	Set motion resolusion
_8136_M_Set_IO_Active(cardno,axisno,ctrl)	Enable motion I/O check
_8136_M_Switch_Logic(card, home, lmt, alm)	Set motion I/O logic
_8136_A_Set_Source(cardno, ch, src)	Choose DAC for motion or not
_8136_M_Set_Feedback(cardno, ax, ctrl)	Set axis0~2 feedback on/off

Motion Status	***Section 5.12***
_8136_M_ORG_Status(cardno, axisno)	Set interrupt event handler
_8136_M_PEL_Status(cardno, axisno)	Remove int. event handler
_8136_M_MEL_Status(cardno, axisno)	Set interrupt factor
_8136_M_ALM_Status(cardno, axisno)	Enable/disable interrupt
_8136_M_Get_Speed(cardno, axisno, *speed)	Get axis speed
_8136_Motion_Status(cardno, axisno)	Get motion status

PTP Movement	***Section 5.13***
_8136_Start_TR_Move(cd,ax,dist,sv,mv,ta,td)	Trapezoidal relative move
_8136_Start_SR_Move(cd,ax,dist,sv,mv,ta,td)	S-Curve relative move
_8136_Start_TA_Move(cd,ax,pos,sv,mv,ta,td)	Trapezoidal absolute move
_8136_Start_SA_Move(cd,ax,pos,sv,mv,ta,td)	S-Curve absolute move

2D Interpolation	***Section 5.14***
_8136_Start_Move_XY(cd,*ax,px,py,sv,mv,ta,td)	2D linear interpolation T-curve
_8136_Start_S_Move_XY(cd,*ax,px,py,sv,mv,ta,td)	2D linear interpolation S-curve
_8136_Start_Arc_XY(cd,*ax,cx,cy,th,sv,mv,ta,td)	2D circular interpolation T-curve
_8136_Start_S_Arc_XY(cd,*ax,cx,cy,th,sv,mv,ta,td)	2D circular interpolation S-curve

3D Interpolation	***Section 5.15***
_8136_Start_Move_XYZ(cd,*ax,px,py,pz,sv,mv,ta,td)	3D linear interpolation T-curve
_8136_Start_S_Move_XYZ(cd,*ax,px,py,pz,sv,mv,ta,td)	3D linear interpolation S-curve

Continusous Motion	***Section 5.16***
_8136_V_Move(cd,ax,sv,mv,ta)	Continuous move T-Curve
_8136_SV_Move(cd,ax,sv,mv,ta)	Continuous move S-Curve

Homing	***Section 5.17***
_8136_Home_Move(card, axis , sv ,mv, ta)	Homing

Other Motion function	***Section 5.18***
_8136_Motion_Stop(card, axis)	Stop motion
_8136_C_Set_Gain(cardno, kp1, kp2)	Set close loop gain

5.2 Initialization

@ Name

_8136_Initial – Software Initialize for PCI-8136

_8136_S_Close – Software release for PCI-8136

_8136_A_Initial – Initialize ADC/DAC functions for PCI-8136

_8136_P_Initial – Initialize pulse output engine and encoder counter

@ Description

_8136_Initial:

This function is used to initialize PCI-8136M card. User must use this function before any operation in the program. This function will return a number to notice user how many cards is found.

_8136_S_Close:

This function is used to close PCI-8136M card. It releases the resources which are declared by driver. User must use this function before the program ends.

_8136_A_Initial:

This function enables serial ADC and DAC functions and set the transmission clock divider. User must use this function before he wants to use Analog IO.

_8136_P_Initial:

This function is for setting the encoder counter's clockand enable pulse output functions. User must use this function to enable pulse input and output.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

```
I16 _8136_Initial(I16 *existCards);
I16 _8136_S_Close(I16 CardNo);
I16 _8136_A_Initial(I16 CardNo);
I16 _8136_P_Initial(I16 CardNo);
U16 _8136_R_Initial(I16 CardNo, I16 SlaveControl);
```

Visual Basic 5.0 or higher

```
B_8136_Initial (existCards As Integer) As Integer
B_8136_S_Close (ByVal CardNo As Integer) As Integer
B_8136_A_Initial (ByVal CardNo As Integer) As Integer
B_8136_P_Initial (ByVal CardNo As Integer) As Integer
```

B_8136_R_Initial (ByVal CardNo As Integer, ByVal SlaveControl As Integer) As Integer

@ **Arguments**

CardNo: card number designated to set (Range 0 ~ 3)
AxisNo: axis number designated to set (Range 0 ~ 5)
*existCards: a return value to indicate how many cards are found
SlaveNo: assign slave number (Range 0~1)
SlaveControl: Enable/Disable Slave Module(1 for enable, 0 for disable)

@ **Return Code**

ERR_RangeError
ERR_PCIBiosNotExist
ERR_NoError

5.3 System Parameters

@ Name

_8136_R_Set_RIO_Clk -Set Rio clock divider

_8136_A_Set_DAC_Clk - Set DAC clock divider

_8136_A_Set_ADC_Clk - Set ADC clock divider

_8136_S_Set_Timer_Value - Set Timer click count

_8136_P_Set_Enc_Filter - Set encoder filter clock

@ Description

_8136_R_Set_RIO_Clk :

PCI-8136M can connect two remote I/O slave module. This function is for setting module's transmission clock. Assign a clock divider number to change its transmission rate. The maximum transmission clock is about 16.7Mhz and the minimum is about 130Khz for each slave module.

_8136_A_Set_DAC_Clk

There are 6 serial type DA channels in PCI-8136. This function is for setting the DAC transmission clock. Assign a clock divider number to change the DAC transmission rate. The maximum transmission clock is about 8.33 Mhz and the minimum is about 65Khz.

_8136_A_Set_ADC_Clk

There are 6 serial type AD channels in PCI-8136. This function is for setting the ADC transmission clock. Assign a clock divider number to change the DAC transmission rate. The maximum transmission clock is about 8.33 Mhz and the minimum is about 65Khz.

_8136_S_Set_Timer_Value

There is a 24-bits counter in PCI-8136. This function is for setting the counter value and receiving a fixed interrupt interval from this timer when the counting is finished . The timer clock rate is 33.3Mhz. If user set the timer value to be 333000 and the interrupt interval will be 10ms.

_8136_P_Set_Enc_Filter

The encoder counter base clock is 33.3Mhz. This function is for setting the encoder counter filter to fit the pulse rate from users. The maximum value for this filter is 127 and it means user's input pulse rate is smaller than 260Khz.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

I16 _8136_R_Set_RIO_Clk(I16 CardNo, I16 SlaveNo, I16 Clk_Divider)
I16 _8136_A_Set_DAC_Clk(I16 CardNo, I16 Clk_Divider)
I16 _8136_A_Set_ADC_Clk(I16 CardNo, I16 Clk_Divider)
I16 _8136_S_Set_Timer_Value(I16 CardNo,U32 TimerValue)
I16 _8136_P_Set_Enc_Filter(I16 CardNo,I16 Filter)

Visual Basic 5.0 or higher

B_8136_R_Set_RIO_Clk(ByVal CardNo As Integer, ByVal SlaveNo As Integer, ByVal Clk_Divider As Integer) As Integer
B_8136_A_Set_DAC_Clk(ByVal CardNo As Integer, ByVal Clk_Divider As Integer) As Integer
B_8136_A_Set_ADC_Clk(ByVal CardNo As Integer, ByVal Clk_Divider As Integer) As Integer
B_8136_S_Set_Timer_Value(ByVal CardNo As Integer , ByVal TimerValue As Long) As Integer
B_8136_P_Set_Enc_Filter(ByVal CardNo As Integer, ByVal Filter As Integer) As Integer

@ Arguments

CardNo: card number designated to set (Range 0 ~ 3)
SlaveNo: Select which slave would be set (Range 0~1)
Clk_Divider: Set transmission clock divider (Range 0~127)
TimerValue: Set timer value (Range28-Bits)
Filter: Set Filter sample clock divider (Range 0~127)

@ Return Code

ERR_RangeError
ERR_NoError

5.4 Card Information

@ Name

_8136_S_Get_IRQ_Channel - Get I/O card's IRQ

_8136_S_Get_Base_Addr - Get I/O card's base address

@ Description

_8136_S_Get_IRQ_Channel:

Although PCI-8136M is a PCI interface card, user can use this function to get the IRQ channel which is assigned by PCI BIOS. This value is no meaning when operating this card. It is only a part of PCI-813's information

_8136_S_Get_Base_Addr

Although PCI-8136M is a PCI interface card, user can use this function to get the I/O Base Address which is assigned by PCI BIOS. This value is no meaning when operating this card. It is only a part of PCI-813's information

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

```
void _8136_S_Get_IRQ_Channel(I16 cardNo, U16 *irq_no )
void _8136_S_Get_Base_Addr(I16 cardNo, U16 *base_addr )
```

Visual Basic 5.0 or higher

```
B_8136_S_Get_IRQ_Channel(ByVal cardNo As Integer, irq_no
    As Integer)
B_8136_S_Get_Base_Addr(ByVal cardNo As Integer, base_addr
    As Integer )
```

@ Arguments

CardNo: card number designated to set (Range 0 ~ 3)
Irq_no: IRQ channel for this card, return value
Base_addr: Base Address for this card, return value

@ Return Code

None

5.5 Digital I/O

@ Name

_8136_D_Output - Digital output for one bit

_8136_D_Input - Digital input for one bit

_8136_D_OutputA - Digital Output for all bits once

_8136_D_InputA - Digital Input for all bits once

@ Description

_8136_D_Output:

There are 7 open collector output channels in PCI-8136. This function is for controlling these output bits by setting them on or off. This function can set each channel individually. Please refer to the pin assignment for bit numbers.

_8136_D_Input

There are 19 open isolated digital input channels in PCI-8136. This function is for getting these input bits by setting them on or off. This function can get each channel individually. Please refer to the pin assignment for bit numbers.

_8136_D_OutputA

There are 7 open collector output channels in PCI-8136. This function is for controlling these output bits by setting them on or off. This function can set all output channels on/off by a value once. Each bit of this value represents the actual output bit. Please refer to the pin assignment for bit numbers.

_8136_D_InputA

There are 19 open isolated digital input channels in PCI-8136. This function is for getting these input bits by setting them on or off. This function can get all input channels' status once. Each bit of this value represents the actual input channel. Please refer to the pin assignment for bit numbers.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

```
U16 _8136_D_Output( I16 CardNo , I16 Channel , I16 Control );
U16 _8136_D_Input( I16 CardNo , I16 Channel , I16* Control );
U16 _8136_D_OutputA( I16 CardNo , I16 Value );
U16 _8136_D_InputA( I16 CardNo , I32 *Value );
```

Visual Basic 5.0 or higher

B_8136_D_Output(ByVal CardNo As Integer, ByVal Channe As Integer, ByVal Control As Integer) As Integer
B_8136_D_Input(ByVal CardNo As Integer, ByVal Channel As Integer, Control As Integer) As Integer
B_8136_D_OutputA (ByVal CardNo As Integer, ByVal Value As Integer) As Integer
B_8136_D_InputA(ByVal CardNo As Integer, Value As Long) As Integer

@ Argument

CardNo: card number designated to set (Range 0 ~ 3)
Channel: channel number designated to set (Range 0 ~ 6)
Control: control value for the designated channel (Range 0 ~ 1)
Value: control value for all digital output (Range 0 ~ 0x7f)
Control: return value for designated channel (Range 0 ~ 1)
Value: return value for all digital input (Range 0 ~ 0x7ffff)

@ Return Code

ERR_RangeError
ERR_NoError

5.6 Remote I/O

@ Name

_8136_R_Status - Check Remote I/O Status

_8136_R_Write - Write a word to remote

_8136_R_Read - Read a word from remote

@ Description

_8136_R_Status:

This function is for checking remote I/O stopped status. If the remote I/O is not running, user can use this function to check to status of remote I/O. It contains the following information: Remote I/O enable/disable, master/slave receive data status, and module fail.

_8136_R_Write

This function is for writing a word to one set. Each slave module has 4 sets. User must assign the slave number and set number and a value to use this function.

_8136_R_Read

This function is for reading a word from one set. Each slave module has 4 sets. User must assign the slave number and set number and a value to use this function.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

```
I16 _8136_R_Status(I16 CardNo);
U16 _8136_R_Write(I16 CardNo,I16 SlaveNo,I16 SetNo,U16
      SetValue);
U16 _8136_R_Read(I16 CardNo,I16 SlaveNo,I16 SetNo,U16
      *SetValue);
```

Visual Basic 5.0 or higher

```
B_8136_R_Status (ByVal CardNo As Integer) As Integer
B_8136_R_Write (ByVal CardNo As Integer, ByVal SlaveNo As
Integer, ByVal SetNo As Integer, ByVal SetValue As Long) As
Integer
B_8136_R_Read (ByVal CardNo As Integer, ByVal SlaveNo As
Integer, ByVal SetNo As Integer, SetValue As Long) As Integer
```

@ Argument

CardNo: card number designated to set (Range 0 ~ 3)
SlaveNo: assign slave number (Range 0~1)

SetNo: I/O range in slave module
0: bit 0~15
1: bit 16~31
2: bit 32~47
3: bit 48~63
SetValue: 16-bit value to write
*SetValue: 16-bit value to read

@ Return Code

ERR_RangeError
ERR_NoError

5.7 Analog I/O

@ Name

_8136_A_Write_Value - Output DAC in value

_8136_A_Write_Volt - Output DAC in voltage

_8136_A_Read_Value - Input from ADC in value

_8136_A_Read_Volt - Input from ADC in voltage

_8136_A_Output_Control - Start or stop DAC output

_8136_A_Set_Trigger - Set DAC output by trigger

_8136_A_Set_Trigger_Map - Select DAC trigger source

_8136_A_Set_Preload_Volt - Set DAC trigger output voltage

_8136_A_Set_Compare_Value - Set ADC compare value

_8136_A_Set_Compare_Volt - Set ADC compare voltage

@ Description

_8136_A_Write_Value

This function is for generating a DC value from DAC channel. The resolution of DA converter is 16-bits. The mapping value for 0 volt is 0x0000 , +10 volt is 0x7fff and –10 volt is 0x8000. There are six channels in one card. All channels are free to run individually.

_8136_A_Write_Volt

This function is for generating a DC value from DAC channel. The resolution of DA converter is 16-bits. User can assign a voltage value to this function directly. The range of voltage value is from –10.0 to +10.0. There are six channels in one card. All channels are free to run individually.

_8136_A_Read_Value

This function is for reading a digital value from ADC channel. The resolution of AD converter is 12-bits. User can read a word from this function. The mapping value for 0V is 2000, +10V is 4000 and –10V is 0. There are six channels in one card. All channels are free to run individually.

_8136_A_Read_Volt

This function is for reading a voltage value from ADC channel. The resolution of AD converter is 12-bits. User can read a voltage value from this function directly. The range of the read-back voltage value is for –10.0V to +10.0V. There are six channels in one card. All channels are free to run individually.

_8136_A_Output_Control

Once user wants to stop outputting any voltage from DA channel, he can use this function to close DA channel immediately. It can be open again by this function too.

_8136_A_Set_Trigger

This function is for enable/disable DA channel output by trigger source. The trigger source would be ADC comparator interrupt or encoder counter comparator interrupt.

_8136_A_Set_Trigger_Map

This function is for assigning each channel's trigger source. The trigger source is selected by one parameter. Each bit of this parameter represents one kind of trigger source. Bit0~5 means trigger source is from encoder counter channel 0~5 and bit8~13 means trigger source is from ADC channel 0~5. Set 1 is for enable and 0 is for disable.

_8136_A_Set_Preload_Volt

Once user set the DAC trigger function, the preload voltage must be set first. When the trigger is active, the DAC channel will output this preload value.

_8136_A_Set_Compare_Value

This function is for DAC trigger output or simply for generating ADC comparator interrupt. When user wants to output a preload voltage which is triggered by ADC level, the trigger level must be set by this function. The trigger level is set by a 12-bits ADC value with a range from 0 to 4000.

_8136_A_Set_Compare_Volt

This function is for DAC trigger output or simply for generating ADC comparator interrupt. When user wants to output a preload voltage which is triggered by ADC level, the trigger level must be set by this function. The trigger level is set by a 12-bits ADC voltage with a range from –10.0 to 10.0.

@ **Syntax**

C/C++ (DOS, Windows 95/98/NT/2000)

I16 _8136_A_Write_Value(I16 CardNo, I16 Channel, I16 Value)
I16 _8136_A_Write_Volt(I16 CardNo, I16 Channel, F64 Volt)
I16 _8136_A_Read_Value(I16 CardNo, I16 Channel, I16 *Value)
I16 _8136_A_Read_Volt(I16 CardNo, I16 Channel, F32 *Volt)
I16 _8136_A_Output_Control(I16 CardNo, I16 Channel, I16 Control)
I16 _8136_A_Set_Compare_Value(I16 CardNo, I16 Channel, I16 Value)
I16 _8136_A_Set_Compare_Volt(I16 CardNo, I16 Channel, F64 Volt)

I16 _8136_A_Set_Trigger_Map(I16 CardNo, I16 Channel, I16 Source)
I16 _8136_A_Set_Trigger(I16 CardNo, I16 Channel, I16 Control)
I16 _8136_A_Set_Preload_Volt(I16 CardNo, I16 Channel, F64 Volt)

Visual Basic 5.0 or higher

B_8136_A_Write_Value (ByVal CardNo As Integer, ByVal Channel As Integer, ByVal Value As Integer) As Integer
B_8136_A_Write_Volt (ByVal CardNo As Integer, ByVal Channel As Integer, ByVal Volt As Single) As Integer
B_8136_A_Read_Value Lib (ByVal CardNo As Integer, ByVal Channel As Integer, Value As Integer) As Integer
B_8136_A_Read_Volt (ByVal CardNo As Integer, ByVal Channel As Integer, Volt As Double) As Integer
B_8136_A_Output_Control (ByVal CardNo As Integer, ByVal Channel As Integer, ByVal Control As Integer) As Integer
B_8136_A_Set_Compare_Value(ByVal CardNo As Integer, ByVal Channel As Integer, ByVal Value As Integer) As Integer
B_8136_A_Set_Compare_Volt (ByVal CardNo As Integer, ByVal Channel As Integer, ByVal Volt As Double) As Integer
B_8136_A_Output_Control (ByVal CardNo As Integer, ByVal Channel As Integer, ByVal Control As Integer) As Integer
B_8136_A_Set_Trigger_Map(ByVal CardNo As Integer,ByVal Channel As Integer, ByVal Source As Integer) As Integer
B_8136_A_Set_Trigger(ByVal CardNo As Integer, ByVal Channel As Integer, ByVal Control As Integer) As Integer
B_8136_A_Set_Preload_Volt(ByVal CardNo As Integer, ByVal Channel As Integer, ByVal Volt As Double) As Integer

@ Argument

CardNo: card number designated to set (Range 0 ~ 3)
Channel: channel number designated to set (Range 0 ~ 6)
Value: the output value for DAC channel (Range –32768 ~ +32767)
Volt: the output voltage for DAC channel (Range –10.0 ~ +10.0)
Value: the input value for ADC channel (Range 0 ~4000)
Volt: the input voltage for ADC channel (Range –10.0 ~ +10.0)
Control: enable or disable trigger (1 for enable/0 for disable)
Source: Set DAC trigger source
Value 0~5 is for encoder 0~5
Value 8~13 is for ADC channel 0~5

@ Return Code

ERR_RangeError
ERR_NoError

5.8 Pulse I/O

@ Name

_8136_P_Set_Output_Type - Set pulse output mode

_8136_P_Set_Input_Type - Set pulse input mode

_8136_P_Read - Read encoder counter

_8136_P_Clear - Clear encoder counter

_8136_P_Send - Send a constant pulse train

_8136_P_Stop - Stop pulse train

_8136_P_Change_Speed - Change pulse train frequency

_8136_P_Read_Index - Read index value

_8136_P_Set_Index_Latch - Set index latch type

_8136_P_Read_Latch_Value - Read a latched encoder data

_8136_P_Set_Compare_Value - Set a encoder compare data

@ Description

_8136_P_Set_Output_Type:

There are 3 pulse output types in PCI-8136. This function is for configuring pulse output type by a value. Write a value 0 is for pulse/direction type. Write a value 1 is for CW/CCW type. Write a value 2 is for A/B phase type.

_8136_P_Set_Input_Type

There are 3 encoder counter input types in PCI-8136. This function is for configuring encoder counter input type. Write a value 0 is for A/B phase type. Write a value 1 is for CW/CCW type. Write a value 2 is for pulse/direction type. When setting A/B phase type, user must assign the multiplier value by this function.

_8136_P_Read

This function is for reading the 32-bits encoder counter value immediately. There are six encoder counters in one card. Assign the channel value 0~5 to read the encoder counter individually. There are three internal counters for receiving pulse output command. When pulse output channel 0~2 is working, their output value will send to both CN1 and internal feedback counter. These three command feedback counters are at channel 6~8. If the channel parameter of this function is assigned as the above three channels, it will read the command value at the same time.

_8136_P_Clear

This function is for clearing the encoder counter value to zero immediately.

_8136_P_Send

This function is for sending a fixed frequency pulse train of each channel. It will output a pre-configured pulse format which is set by P_Set_Output_Type().

_8136_P_Stop

This function is for stopping the output pulse for each channel.

_8136_P_Change_Speed

This function is for changing the output pulse frequency on line.

_8136_P_Read_Index

There are 6 index signal input in one PCI-8136. This function is for checking the index status on or off. Each bit of this status value represents a index status.

_8136_P_Set_Index_Latch

The index signal is also a trigger source for latching the respective encoder counter value. There are two modes for this latch. Set 0 to be first trigger latch and set 1 to be last trigger latch. First trigger latch means only trigger once and last trigger latch means latch every time if index signal comes.

_8136_P_Read_Latch_Value:

Once the encoder counter is latched. Use this function can get the counter value at latched moment. It will not be clear until next index latched signal is coming.

_8136_P_Set_Compare_Value

There are 6 encoder counters in PCI-8136. Each encoder can set a compare value individually. This compare value is also a 32-bits value.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

```
I16 _8136_P_Set_Output_Type(I16 CardNo, I16 ChannelNo, I16
    PulseFmt);
I16 _8136_P_Set_Input_Type(I16 CardNo, I16 EncNo, I16
    EncFmt, I16 Mul);
I16 _8136_P_Read(I16 CardNo, I16 EncNo, I32 *EncData);
I16 _8136_P_Send(I16 CardNo,I16 ChannelNo,F64 FrqL);
I16 _8136_P_Stop(I16 CardNo,I16 ChannelNo);
I16 _8136_P_Clear(I16 CardNo, I16 EncNo);
I16 _8136_P_Set_Compare_Value(I16 CardNo,I16 EncNo, I32
    CompValue);
```

I16 _8136_P_Read_Latch_Value(I16 CardNo, I16 EncNo, I32 *Value)
I16 _8136_P_Set_Index_Latch(I16 CardNo, I16 WhichIndex, I16 Type);
I16 _8136_P_Read_Index(I16 CardNo, I16 AxisNo, I16 *Index);
I16 _8136_P_Change_Speed(I16 CardNo,I16 AxisNo,F32 Frq);

Visual Basic 5.0 or higher

B_8136_P_Initial (ByVal CardNo As Integer) As Integer
B_8136_P_Set_Output_Type (ByVal CardNo As Integer, ByVal AxisNo As Integer, ByVal PulseFmt As Integer) As Integer
B_8136_P_Set_Input_Type (ByVal CardNo As Integer, ByVal EncNo As Integer, ByVal EncFmt As Integer, ByVal Mul As Integer) As Integer
B_8136_P_Read (ByVal CardNo As Integer, ByVal EncNo As Integer, EncData As Long) As Integer
B_8136_P_Send (ByVal CardNo As Integer, ByVal AxisNo As Integer, ByVal FrqL As Double) As Integer
B_8136_P_Stop (ByVal CardNo As Integer, ByVal AxisNo As Integer) As Integer
B_8136_P_Clear (ByVal CardNo As Integer, ByVal EncNo As Integer) As Integer
B_8136_P_Set_Compare_Value (ByVal CardNo As Integer, ByVal EncNo As Integer, ByVal CompValue As Long) As Integer
B_8136_P_Read_Latch_Value(ByVal CardNo As Integer, ByVal EncNo As Integer, Value As Long) As Integer
B_8136_P_Set_Index_Latch (ByVal CardNo As Integer, ByVal WhichIndex As Integer, ByVal LatchType As Integer) As Integer
B_8136_P_Read_Index (ByVal CardNo As Integer, ByVal AxisNo As Integer, Index As Integer) As Integer
B_8136_P_Change_Speed (ByVal CardNo As Integer, ByVal AxisNo As Integer, ByVal Frq As Single) As Integer

@ Argument

CardNo: card number designated to set (Range 0 ~ 3)
ChannelNo: channel number designated to set (Range 0 ~ 6)
EncNo: encoder channel number designated to set (Range 0 ~ 6)
PulseFmt: Output pulse format
0 = Pulse/Direction
1 = CW/CCW
2 = A/B Phase
EncFmt: Input pulse format:
0 = A/B Phase
1 = CW/CCW
2 = Pulse/Direction

Mul: for A_B type's mutiplier
0 = 0X A_B Phase
1 = 1X A_B Phase
2 = 2X A_B Phase
3 = 4X A_B Phase
EncData: read back encoder data
FrqL: Pulse output frequency (Range 0~500k Hz)
CompValue: Encoder Compare Value
*Index: Index Status (0 or 1)
Type: two trigger latch mode: 0 for first trigger, 1 for last trigger
WhichIndex: select index no. (0~5)
Frq: Pulse output frequency for change (Range 0~500k Hz)

@ Return Code

ERR_RangeError
ERR_PCIBiosNotExist
ERR_NoError

5.9 Interrupt Control

@ Name

_8136_INT_Enable - Set interrupt event handler

_8136_INT_Disable - Remove int. event handler

_8136_S_Set_Int_Factor - Set interrupt factor

_8136_S_INT_Control - Enable/disable interrupt

_8136_S_Get_Int_Status - Get Int. status

_8136_Callback_Function - Set a call back function for int

@ Description

_8136_INT_Enable

This function is only for Windows system. It allocates interrupt events in Windows system for passing message to application from kernel.

_8136_INT_Disable

This function is only for Windows system. It clear event resources which is allocated by INT_Enable() function.

_8136_S_Set_Int_Factor

This function is for setting interrupt source for each channel. Every channel has 6 types of interrupt can be set. It includes four digital input interrupt, index interrupt, encoder compare interrupt, timer interrupt and voltage compare interrupt.

_8136_S_INT_Control

This function controls the hardware interrupt pin. The interrupt won't come if this function hasn't used.

_8136_S_Get_Int_Status

Once the interrupt comes, user must use this function to check the interrupt types. There are 6 types of interrupt at one interrupt event. User must check what kinds of interrupt is coming this time. Two or more interrupt will comes at the same time. User must check each it to prevent lost any interrupt events.

_8136_Callback_Function

This function can set a user-defined function to be an ISR. When one interrupt comes, this user-defined function will wake up at the same time. Be careful to deal with this function. Don't take too much time inside this function.

@ **Syntax**

C/C++ (DOS, Windows 95/98/NT/2000)

U16_8136_INT_Enable(I16 CardNo, HANDLE *phEvent); (Windows Only)
U16 _8136_INT_Disable(I16 CardNo); (Windows Only)
void _8136_S_INT_Control(I16 CardNo, U16 intFlag)
U16 _8136_S_Set_Int_Factor(I16 CardNo, I16 ChannelNo, U16 IntFactor)
U16 _S_Get_Int_Status(I16 CardNo,I16 AxisNo,U16 *IntStatus)
void _8136_Callback_Function(I16 CardNo,void *callbackAddr(I16 AxisNo, U16 IntSts))

Visual Basic 5.0 or higher

B_8136_INT_Enable (ByVal card_number As Integer, phEvent As Long) As Integer
B_8136_INT_Disable (ByVal card_number As Integer) As Integer
B_8136_S_INT_Control (ByVal CardNo As Integer, ByVal intFlag As Integer)
B_8136_S_Set_Int_Factor (ByVal CardNo As Integer, ByVal AxisNo As Integer, ByVal IntFactor As Integer, ByVal OptionType As Integer) As Integer
B_8136_S_Get_Int_Status (ByVal CardNo As Integer, ByVal AxisNo As Integer, IntStatus As Long) As Integer
B_8136_Callback_Function (ByVal CardNo As Integer, ByVal lpCallBackProc As Long) As Integer

@ **Arguments**

CardNo: card number designated to set (Range 0 ~ 3)
ChannelNo: channel number designated to set (Range 0 ~ 6)
*phEvent: event handler array contains 7 handler for each card in Windows interrupt system
*existCards: a return value to indicate how many cards are found
intFlag: enable or disable interrupt signal (Range 0~1)
intFactor: enable or disable interrupt for each type in each bit:
bit0: Limit switch on
bit1: Emergency stop on
bit2: Home switch on
bit3: Index signal on
bit4: Encoder value compared
bit5: Timer interrupt
bit6: ADC pre-load value reached
*IntStatus: Read the interrupt status of one axis. To adjudge which interrupt is coming.
bit0: Positive Limit switch on
bit1: Minus Limit switch on
bit2: Emergency stop on

bit3: Home switch on
bit4: Index signal on
bit5: Encoder value compared
bit6: Timer interrupt
bit7: ADC pre-load value reached

OptionType: Set ADC compare direction
1 = Rising Direction
2 = Falling Driection
3 = Both Direction

*callbackAddr(I16 AxisNo, U16 IntSts) : function pointer type

@ Return Code

ERR_RangeError
ERR_NoError

5.10 Close Loop Initialization

@Name

_8136_C_Initial – Closed loop motion control initialize

@Description

_8136_C_Initial:

There are 6 motion axes in one PCI-8136M. User can choose some or all of them to run in closed loop control mode by this function. In closed loop control mode, the specific DA channel and encoder counter channel are used for closed loop control. That means two different control modes, pulse and V command, can be used in one card at the same time. Users can choose any axis for V command mode and the other axes for pulse command mode. Users also can utilize other channels which are not for motion to get data or send command. Default situation is for pulse command, open loop mode after you use P_Initial() command. If users wants to use closed loop control mode, they must use P_Initial() first then C_Initial().

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

I16_8136_C_Initial(I16 CardNo, I16 AxisNo)

Visual Basic 5.0 or higher

B_8136_C_Initial(ByVal CardNo As Integer, ByVal AxisNo As Integer) As Integer

@ Argument

CardNo: card number designated to set (Range 0 ~ 3)
AxisNo: axis number designated to set (Range 0 ~ 5)

@ Return Code

ERR_RangeError
ERR_NoError

5.11 Motion Parameters

@Name

_8136_M_Set_System_Param – Set motion cycle time and speed

_8136_M_Set_IO_Active – Enable/disable motion I/O

_8136_M_Switch_Logic – Set motion I/O's logic

_8136_A_Set_Source – Switch DAC source

_8136_M_Set_Feedback – Set axis0~2 encoder feedback on/off

@Description

_8136_M_Set_System_Param:

This function is for users to choose motion system's maximum speed and motion loop's cycle time. The following table shows the choices in PCI-8136. There are six types for speed selection, 32k, 64k, 128k, 256k, 512k, and 1024k. The corresponding pulse width for these speeds are 32us, 16us, 8us, 4us, 2us, and 1us. If users use pulse type motor driver, please make sure your specification. The cycle time for motion loop is adjustable only for 512k and 1024k. The other speed types have fixed cycle time. The corresponding cycle time for 32k, 64k, 128k, 256k are 32.768ms, 16.384ms, 8.192ms and 4.096ms. Windows NT system is not a real time system so please choose the most suitable and stable cycle time for your system.

_8136_M_Set_IO_Active

This function enables PEL/MEL/ALM/ORG checking when sending pulses. For example, one user needs to use axis0 and axis 1 for motion control. He must use this function to enable PEL/MEL/ALM/ORG checking for these two axes. If not , these I/Os can be used for general purpose I/O.

_8136_M_Switch_Logic

This function is for setting three I/O types, ORG, EL, ALM, for generating interrupt or doing their particular job. These I/O may be active high or low. Use this function to set their logic properly if you use interrupt functions or motion function.

_8136_A_Set_Source

When users use one axis for closed loop motion control by C_Initial(). The DA channel is used for generating V command from motion pattern. This function can switch this axis for general purpose DA channel or closed loop control mode.

_8136_M_Set_Feedback

When users are using absolute position control motion functions, PCI-8136M will read current position counter value for calculating next position. If users don't connect any feedback device, they can use this function to disable external feedback. Then the absolute function will be valid. There are only first three axes supports these functions. The other three axes must connect feedback device if they are using absolute position motion functions.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

I16 _8136_M_Switch_Logic(I16 CardNo,I16 Home_Logic, I16 EL_Logic, I16 ALM_Logic)
I16 _8136_M_Set_IO_Active(I16 CardNo, I16 AxisNo, I16 Control)
I16 _8136_M_Set_System_Param(I16 CardNo, I16 Speed, I16 CycleTime)
I16 _8136_A_Set_Source(I16 CardNo,I16 Channel,I16 Source)
I16 _8136_M_Set_Feedback(I16 CardNo, I16 AxisNo, I16 FBControl)

Visual Basic 5.0 or higher

B_8136_M_Switch_Logic (ByVal CardNo As Integer,ByVal Home_Logic As Integer,ByVal EL_Logic As Integer, ByVal ALM_Logic As Integer) As Integer
B_8136_M_Set_IO_Active(ByVal CardNo As Integer, ByVal AxisNo As Integer, ByVal Control As Integer) As Integer
B_8136_M_Set_System_Param(ByVal CardNo As Integer, ByVal Speed As Integer, ByVal CycleTime As Integer) As Integer
B_8136_A_Set_Source(ByVal CardNo As Integer, ByVal Channel As Integer, ByVal Source As Integer)
B_8136_M_Set_Feedback(ByVal CardNo As Integer, ByVal AxisNo As Integer, ByVal FBControl As Integer) As Integer

@ Argument

CardNo: card number designated to set (Range 0 ~ 3)
AxisNo: axis number designated to set (Range 0~5)
Source: select DAC source, 0 is from DAC buffer and 1 is from motion command
Home_Logic: 0 is for active low and 1 is for active high
EL_Logic: 0 is for active low and 1 is for active high
ALM_Logic: 0 is for active low and 1 is for active high
Control: 0 is for general purpose and 1 is for motion axis
FBControl: only for axis0 to 2, 0 means disable feedback device and 1 means enable feedback device
Speed: select motion axis maximum speed
0 = 32k
1 = 64k

2 = 128k
3 = 256k
4 = 512k
5 = 1024k

CycleTime: select motion cycle time
0 = 1.024ms (for 1024k only)
1 = 2.048ms (for 512k and 1024k only)
3 = 4.096ms (for 256, 512k and 1024k only)

@ **Return Code**

ERR_RangeError
ERR_NoError

5.12 Motion Status

@Name

_8136_M_ORG_Status – Check origin point's high/low

_8136_M_PEL_Status – Check positive point's high/low

_8136_M_MEL_Status – Check minus point's high/low

_8136_M_ALM_Status – Check alarm point's high/low

_8136_Motion_Status – Check current axis' motion status

_8136_M_Get_Speed – Get one axis' current speed

@Description

_8136_M_ORG_Status:

There are 6 ORG digital input pins in PCI-8136M. Every axis has one ORG pin for homing. This function is for checking the ORG pin's status.

_8136_M_PEL_Status:

There are 6 PEL(positive limit switch) digital input pins in PCI-8136M. Every axis has one PEL pin for protection. This function is for checking the PEL pin's status.

_8136_M_MEL_Status:

There are 6 MEL(minus limit switch) digital input pins in PCI-8136M. Every axis has one MEL pin for protection. This function is for checking the MEL pin's status.

_8136_M_ALM_Status:

There is one ALM(alarm switch) digital input pins in PCI-8136M. Every PCI-8136M has one ALM pin for protection. This function is for checking the ALM pin's status.

_8136_Motion_Status:

This function is for checking one axis' motion status. There are two states for one axis. One is busy and the other is not busy.

_8136_M_Get_Speed:

This function is for getting one axis' current moving speed. Its unit is pulse/second. This speed information is from pulse output side, not encoder feedback side.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

I16 _8136_M_ORG_Status(I16 CardNo,I16 Channel)
I16 _8136_M_PEL_Status(I16 CardNo,I16 Channel)

I16 _8136_M_MEL_Status(I16 CardNo,I16 Channel)
I16 _8136_M_ALM_Status(I16 CardNo)
I16 _8136_Motion_Status(I16 CardNo,I16 AxisNo)
I16 _8136_M_Get_Speed(I16 CardNo,I16 AxisNo,F64 *Speed)

Visual Basic 5.0 or higher

B_8136_M_ORG_Status (ByVal CardNo As Integer, ByVal Channel As Integer) As Integer
B_8136_M_PEL_Status (ByVal CardNo As Integer, ByVal Channel As Integer) As Integer
B_8136_M_MEL_Status (ByVal CardNo As Integer, ByVal Channel As Integer) As Integer
B_8136_M_ALM_Status (ByVal CardNo As Integer)
B_8136_Motion_Status (ByVal CardNo As Integer, ByVal AxisNo As Integer) As Integer
B_8136_M_Get_Speed(ByVal CardNo As Integer, ByVal AxisNo As Integer, Speed As Double) As Integer

@ Argument

CardNo: card number designated to set (Range 0 ~ 3)
AxisNo: axis number designated to set (Range 0~5)
Channel: Channel number, the same with AxisNo
*Speed: Output pulse rate

@ Return Code

I/O status 0 or 1
ERR_RangeError
ERR_NoError

5.13 PTP Movement

@Name

_8136_Start_TR_Move – Start a trapezoidal relative PTP move

_8136_Start_SR_Move – Start a S-curve relative PTP move

_8136_Start_TA_Move – Start a trapezoidal absolute PTP move

_8136_Start_SA_Move – Start a S-curve absolute PTP move

@Description

_8136_Start_TR_Move:

This function is for users to start a trapezoidal velocity profile relative PTP motion. It wont' occupy user's program after it starts.

_8136_Start_SR_Move:

This function is for users to start a S-Curve velocity profile relative PTP motion. It wont' occupy user's program after it starts.

_8136_Start_TA_Move:

This function is for users to start a trapezoidal velocity profile absolute PTP motion. It wont' occupy user's program after it starts.

_8136_Start_SA_Move:

This function is for users to start a S-Curve velocity profile absolute PTP motion. It wont' occupy user's program after it starts.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

I16 _8136_Start_TR_Move(I16 CardNo,I16 AxisNo,I32 Dist,F64 StrVel,F64 MaxVel,F64 Tacc,F64 Tdec);
I16 _8136_Start_SR_Move(I16 CardNo,I16 AxisNo,I32 Dist,F64 StrVel,F64 MaxVel,F64 Tacc,F64 Tdec);
I16 _8136_Start_TA_Move(I16 CardNo,I16 AxisNo,I32 Pos,F64 StrVel,F64 MaxVel,F64 Tacc,F64 Tdec);
I16 _8136_Start_SA_Move(I16 CardNo,I16 AxisNo,I32 Pos,F64 StrVel,F64 MaxVel,F64 Tacc,F64 Tdec);

Visual Basic 5.0 or higher

B_8136_Start_TR_Move (ByVal CardNo As Integer, ByVal AxisNo As Integer,ByVal Dist As Long,ByVal StrVel As Double, ByVal MaxVel As Double, ByVal Tacc As Double, ByVal Tdec As Double)
B_8136_Start_SR_Move (ByVal CardNo As Integer, ByVal AxisNo As Integer,ByVal Dist As Long,ByVal StrVel As Double,

ByVal MaxVel As Double, ByVal Tacc As Double, ByVal Tdec As Double)

B_8136_Start_TA_Move (ByVal CardNo As Integer, ByVal AxisNo As Integer,ByVal Pos As Long,ByVal StrVel As Double, ByVal MaxVel As Double, ByVal Tacc As Double, ByValTdec As Double)

B_8136_Start_SA_Move (ByVal CardNo As Integer, ByVal AxisNo As Integer,ByVal Pos As Long,ByVal StrVel As Double, ByVal MaxVel **As Double, ByVal Tacc As Double, ByVal Tdec As Double)**

@ Argument

CardNo: card number designated to set (Range 0 ~ 3)
AxisNo: axis number designated to set (Range 0~5)
Dist: PTP distance in pulse (Range: 32bits)
Pos: PTP absolute position in pulse(Range: 32bits)
StrVel: starting velocity
MaxVel: maximum velocity
Tacc: acceleration time
Tdec: deceleration time

@ Return Code

ERR_RangeError
ERR_NoError

5.14 2D Interpolation

@Name

_8136_Start_Move_XY – Start a trapezoidal 2 axes linear interpolation motion

_8136_Start_Arc_XY – Start a trapezoidal 2 axes circular interpolation motion

_8136_Start_S_Move_XY –Start a trapezoidal 2 axes linear interpolation motion

_8136_Start_S_Arc_XY – Start a trapezoidal 2 axes circular interpolation motion

@Description

_8136_Start_Move_XY:

This function is for 2D linear interpolation of trapezoidal velocity profile motion with absolute position for any two axes in one Card.

_8136_Start_Arc_XY:

This function is for 2D circular interpolation of trapezoidal velocity profile motion with absolute position for any two axes in one Card.

_8136_Start_S_Move_XY:

This function is for 2D linear interpolation of S-curve velocity profile motion with absolute position for any two axes in one Card._8136_Start_S_Move_XY:

_8136_Start_S_Arc_XY:

This function is for 2D circular interpolation of S-curve velocity profile motion with absolute position for any two axes in one Card.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

I16 _8136_Start_Move_XY(I16 CardNo, I16* AxisArray,I32 PX, I32 PY, F64 StrVel,F64 MaxVel,F64 Tacc,F64 Tdec)
I16 _8136_Start_Arc_XY(I16 CardNo, I16* AxisArray, I32 PX, I32 PY, F64 Angle, F64 StrVel, F64 MaxVel, F64 Tacc, F64 Tdec)
I16 _8136_Start_S_Move_XY(I16 CardNo, I16* AxisArray,I32 PX, I32 PY, F64 StrVel,F64 MaxVel,F64 Tacc,F64 Tdec)
I16 _8136_Start_S_Arc_XY(I16 CardNo, I16* AxisArray, I32 PX, I32 PY, F64 Angle, F64 StrVel, F64 MaxVel, F64 Tacc, F64 Tdec)

Visual Basic 5.0 or higher

B_8136_Start_Move_XY (ByVal CardNo As Integer, AxisArray() As Integer,ByVal PX As Long, ByVal PY As Long, ByVal StrVel As Double, ByVal MaxVel As Double, ByVal Tacc As Double, ByVal Tdec As Double) As Integer

B_8136_Start_Arc_XY (ByVal CardNo As Integer, AxisArray() As Integer,ByVal PX As Long, ByVal PY As Long, F64 Angle, ByVal StrVel As Double, ByVal MaxVel As Double, ByVal Tacc As Double, ByVal Tdec As Double) As Integer

B_8136_Start_S_Move_XY (ByVal CardNo As Integer, AxisArray() As Integer,IByVal PX As Long, ByVal PY As Long, ByVal StrVel As Double, ByVal MaxVel As Double, ByVal Tacc As Double, ByVal Tdec As Double) As Integer

B_8136_Start_S_Arc_XY (ByVal CardNo As Integer, AxisArray() As Integer, ByVal PX As Long, ByVal PY As Long, ByVal Angle As Double, ByVal StrVel As Double, ByVal MaxVel As Double, ByVal Tacc As Double, ByVal Tdec As Double) As Integer

@ Argument

CardNo: card number designated to set (Range 0 ~ 3)
AxisNo: axis number designated to set (Range 0~5)
PX: arc center x position or line x position
PY: arc center y position or line y position
Angle: arc angle
StrVel: starting velocity
MaxVel: maximum velocity
Tacc: acceleration time
Tdec: deceleration time

@ Return Code

ERR_RangeError
ERR_NoError

5.15 3D Interpolation

@Name

_8136_Start_Move_XYZ – start a 3 axis linear interpolation with trapezoidal velocity profile

_8136_Start_S_Move_XYZ – start a 3 axis linear interpolation with S-Curve velocity profile

@Description

_8136_Start_Move_XYZ:

This function is for 3D linear interpolation of trapezoidal velocity profile motion with absolute position for any three axes in one Card.

_8136_Start_S_Move_XYZ:

This function is for 2D circular interpolation of S-Curve velocity profile motion with absolute position for three two axes in one Card.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

I16 _8136_Start_Move_XYZ(I16 CardNo, I16* AxisArray,I32 PX, I32 PY, I32 PZ, F64 StrVel,F64 MaxVel,F64 Tacc,F64 Tdec)

I16 _8136_Start_S_Move_XYZ(I16 CardNo, I16* AxisArray,I32 PX, I32 PY, I32 PZ, F64 StrVel,F64 MaxVel,F64 Tacc,F64 Tdec)

Visual Basic 5.0 or higher

B_8136_Start_Move_XYZ(ByVal CardNo As Integer, AxisArray As Integer, ByVal PX As Long, ByVal PY As Long, ByVal PZ As Long, ByVal StrVel As Double, ByVal MaxVel As Double,ByVal Tacc As Double, ByVal Tdec As Double) As Integer

B_8136_Start_S_Move_XYZ(ByVal CardNo As Integer, AxisArray As Integer, ByVal PX As Long, ByVal PY As Long, ByVal PZ As Long, ByVal StrVel As Double, ByVal MaxVel As Double,ByVal Tacc As Double, ByVal Tdec As Double) As Integer

@ Argument

CardNo: card number designated to set (Range 0 ~ 3)
AxisNo: axis number designated to set (Range 0~5)
PX: line x position
PY: line y position
PZ: line z position
StrVel: starting velocity
MaxVel: maximum velocity
Tacc: acceleration time in seconds
Tdec: deceleration time in seconds

@ Return Code

ERR_RangeError
ERR_NoError

5.16 Continuous Motion

@Name

_8136_V_Move – Trapezoidal continuous move for one axis

_8136_SV_Move – S-curve continuous move for one axis

@Description

_8136_V_Move:

This function is for continuous move. Continuous move means it has no destination but it has acceleration stage when it starts. This function is for trapezoidal acceleration move of one axis

_8136_SV_Move:

This function is for continuous move. Continuous move means it has no destination but it has acceleration stage when it starts. This function is for S-curve acceleration move of one axis

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

I16 _8136_V_Move(I16 CardNo,I16 AxisNo,F64 StrVel,F64 MaxVel,F64 Tacc);
I16 _8136_SV_Move(I16 CardNo,I16 AxisNo,F64 StrVel,F64 MaxVel,F64 Tacc);

Visual Basic 5.0 or higher

B_8136_V_Move (ByVal CardNo As Integer, ByVal AxisNo As Integer,ByVal StrVel As Double,ByVal MaxVel As Double,ByVal Tacc As Double)
B_8136_SV_Move (ByVal CardNo As Integer, ByVal AxisNo As Integer,ByVal StrVel As Double,ByVal MaxVel As Double,ByVal Tacc As Double)

@ Argument

CardNo: card number designated to set (Range 0 ~ 3)
AxisNo: axis number designated to set (Range 0~5)
StrVel: starting velocity
MaxVel: maximum velocity
Tacc: acceleration time in seconds

@ Return Code

ERR_RangeError
ERR_NoError

5.17 Homing

@Name

_8136_Home_Move – Start to search ORG pin for homing

@Description

_8136_Home_Move:

By giving home search direction, PCI-8136M will auto searching the ORG signal for homing. After it reach the ORG pin. The encoder counter will reset to zero at the same time.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

I16 _8136_Home_Move(I16 CardNo,I16 AxisNo,F64 StrVel,F64 MaxVel,F64 Tacc)

Visual Basic 5.0 or higher

B_8136_Home_Move (ByVal CardNo As Integer, ByVal AxisNo As Integer,ByVal StrVel As Double,ByVal MaxVel As Double,ByVal Tacc As Double) As Integer

@ Argument

CardNo: card number designated to set (Range 0 ~ 3)
AxisNo: axis number designated to set (Range 0~5)
StrVel: starting velocity
MaxVel: maximum velocity
Tacc: acceleration time

@ Return Code

ERR_RangeError
ERR_NoError

5.18 Motion Function

@Name

_8136_Motion_Stop – Stop motion for one axis

_8136_C_Set_Gain – Tuning closed loop gain for one axis

@Description

_8136_Motion_Stop:

This function is for stopping motion command immediately. The pulse generator will stop sending any command to driver.

_8136_C_Set_Gain:

This function is for tuning two closed loop parameters for V-command control mode. One parameter is Multiplicand gain (Kp1) and the other is shift gain (Kp2). The total compensation gain is Kp1*(2^(Kp2))/16.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

I16 _8136_Motion_Stop(I16 CardNo,I16 AxisNo)
I16 _8136_C_Set_Gain(I16 cardNo, I16 Axis,I16 Kp1,I16 Kp2)

Visual Basic 5.0 or higher

B_8136_Motion_Stop (ByVal CardNo As Integer, ByVal AxisNo As Integer) As Integer
B_8136_C_Set_Gain(ByVal cardNo As Integer, ByVal Axis As Integer, ByVal Kp1 As Integer, ByVal Kp2 As Integer)

@ Argument

CardNo: card number designated to set (Range 0 ~ 3)
AxisNo: axis number designated to set (Range 0~5)
Kp1: multiplicand gain (Range: 0~127)
Kp2: shift gain (Range –7~ +7)

@ Return Code

ERR_RangeError
ERR_NoError

Product Warranty/Service

ADLINK warrants that equipment furnished will be free from defects in material and workmanship for a period of one year from the date of shipment. During the warranty period, we shall, at our option, either repair or replace any product that proves to be defective under normal operation.

This warranty shall not apply to equipment that has been previously repaired or altered outside our plant in any way as to, in the judgment of the manufacturer, affect its reliability. Nor will it apply if the equipment has been used in a manner exceeding its specifications or if the serial number has been removed.

ADLINK does not assume any liability for consequential damages as a result from our product uses, and in any event our liability shall not exceed the original selling price of the equipment. The remedies provided herein are the customer's sole and exclusive remedies. In no event shall ADLINK be liable for direct, indirect, special or consequential damages whether based on contract of any other legal theory.

The equipment must be returned postage-prepaid. Package it securely and insure it. You will be charged for parts and labor if the warranty period is expired or the product is proves to be misuse, abuse or unauthorized repair or modification.